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ABSTRACT

Project AIMS (Activities to Integrate Mathematics and Science) has as its purpose the integration of subject matter in grades K-9 on the premise that such integration enriches and makes learning meaningful and holistic. In fact, extensive field testing of the curriculum materials produced by AIMS has confirmed that integration produces the following beneficial results: (1) mathematics becomes more meaningful, hence more useful; (2) science is increasingly studied and understood, with a significant economy of time; (3) there is improved quality of learning and retention; and (4) there is a dramatic increase in students' motivation and involvement. This teaching guide to geography for grades 4-9 contains 32 lessons, each with a teaching instructions page with lists of materials, objectives and procedures, and reproducible worksheets for students. Topics include: (1) "Around the Globe"; (2) "General Geography"; (3) "Grids and Scales"; (4) "Road Maps"; and (5) "Relief Maps." Also included is a checklist of social science processes, science processes and math skills; a list of children's literature which may be used to extend these lessons, a list of materials for the unit, various outline maps, and information on the AIMS project. (CW)

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Finding Your Bearings

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Project AIMS
Grades 4-9

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Project AIMS
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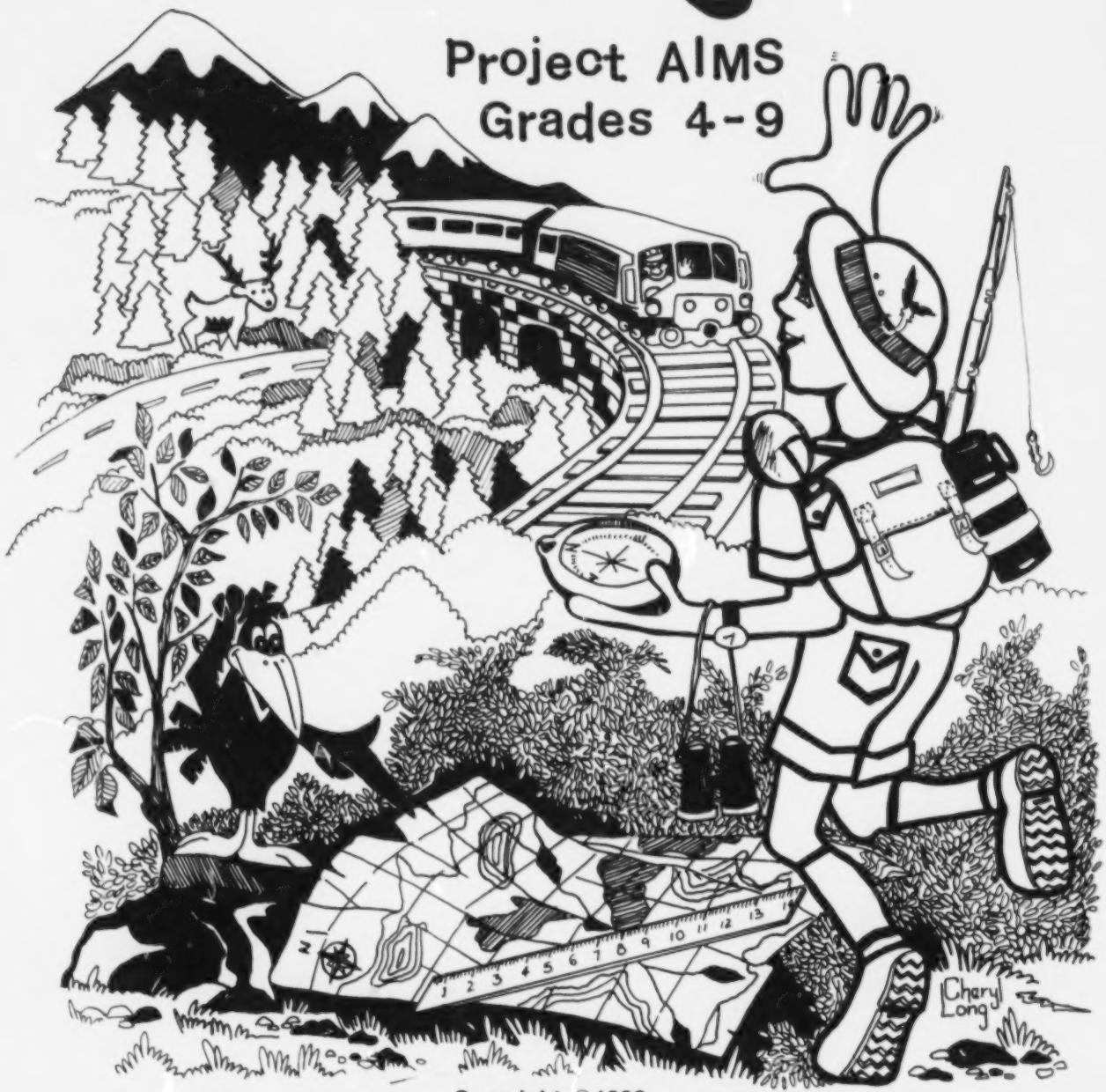

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Project AIMS

Project AIMS has as its purpose the integration of subject matter in K-9. Such integration enriches and makes learning meaningful and holistic. Project AIMS began as a program to integrate mathematics and science, but has since developed to also include language arts, social studies, and other disciplines. The acronym "AIMS" stands for "activities to integrate mathematics and science."

Project AIMS is a continuing, non-profit project of Fresno Pacific College. It had its inception in a National Science Foundation funded program to train teachers in the integration of mathematics and science. This quickly created the necessity to write instructional materials incorporating this concept. Despite the fact that thoughtful educators have long recommended this approach, very little appropriate material was available.

Currently, Project AIMS is funded solely through the sale of this developing series of books. All net proceeds from their sale flow into a trust fund administered by Fresno Pacific College. The use of this fund is restricted to the support of continued research and development, partial scholarships for classroom teachers who participate in the writing and field testing teams, and the publication of the books.

The rationale for this integrative thrust lies in the fact that science, mathematics, language arts, social studies, etc., are integrally interwoven in the real world outside the classroom, from which it follows that they should be similarly treated in the classroom if we are to prepare our students for life in that world. Teachers who have used Project AIMS lessons give enthusiastic endorsement to the effectiveness of this approach.

Science encompasses the art of questioning, investigating, hypothesizing, and discovering. Mathematics is the language that provides clarity, objectivity, and understanding. The language arts provide us with powerful tools of communication. Many of the major contemporary issues involve societal issues stemming from advancements in science. It is time, therefore, that all of us in the teaching profession take seriously using a more holistic mode of transmitting knowledge to students. It is this that motivates all of us who are involved in creating or using the integrative materials of Project AIMS. We invite you to join us in this effort.

Extensive field testing of these materials confirms the following beneficial results.

1. Mathematics becomes more meaningful, hence more useful, when it is applied to situations that interest students.

2. The extent to which science is studied and understood is increased, with a significant economy of time resulting from the integration of two or more disciplines.

3. There is improved quality of learning and retention, supporting the thesis that learning which is meaningful and relevant is more effective.

4. Motivation and involvement are increased dramatically as students investigate real world situations and participate actively in the process.

We invite you to become part of this classroom teacher movement by using an integrated approach and by sharing any suggestions you may have or investigations you would recommend. Project AIMS welcomes you!

Project AIMS Publications

GRADES 5–9 SERIES

Math + Science, A Solution

The Sky's the Limit

From Head to Toe

Fun With Foods

Floaters and Sinkers

Down to Earth

Our Wonderful World

Pieces and Patterns, A Patchwork in Math and Science

Piezas y Diseños, un Mosaic de MATEMÁTICAS y CIENCIAS

Out of This World, Book A

Soap Films and Bubbles (4-9)

Finding Your Bearings

GRADES K–4 SERIES

Fall Into Math and Science

Cáete de gusto hacia el OTOÑO con las MATHEMÁTICAS y CIENCIAS

Glide Into Winter With Math and Science

Patine Al INVIERNO con MATEMÁTICAS y CIENCIAS

Spring Into Math and Science

Brinca de alegria hacia la PRIMAVERA con las MATEMÁTICAS y CIENCIAS

Seasoning Math and Science, Book A (Fall and Winter)

Seasoning Math and Science, Book B (Spring and Summer)

Jawbreakers and Heartthumpers

Hardhatting in a Geo-World

Popping With Power

Overhead and Underfoot

Primarily Plants

Primarily Physics

GRADES K–6

Primarily Bears, Book 1

Water Precious Water, Book A

Critters

Mostly Magnets

FOR FURTHER INFORMATION WRITE TO:

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I HEAR, AND I FORGET

I SEE, AND I REMEMBER

I DO, AND I UNDERSTAND

–Chinese Proverb

INTRODUCTION

The Earth does not seem as big as it used to be. Its physical size remains the same; it is the speed with which we can reach other countries that has changed. Links to most any place on the Earth can be made instantly via satellite transmissions, fax machines, and computer telecommunication lines. Foreign countries are only a few hours away by jet. The world is truly our neighbor and we need citizens who are geographically literate.

Welcome to adventures in geography, adventures which integrate social science with math and science. Social science comes alive when taken out of textbooks and put into the hands of the students.

For too long, social science has been considered a "read and answer questions" subject. We have all experienced the agony of memorizing lists of dates and facts. Social science takes on new meaning when combined with real world experiences and scientific discovery. The concepts become explorations that stimulate both creative and critical thought.

But, more than just working with objects, your students will have the chance to work with each other. They will practice essential social skills such as cooperating and compromising.

In *Finding Your Bearings*, students will have opportunities to discover, experience, and experiment with globes, road maps, relief maps, basketball courts, and shopping malls.

You may choose excursions through your room or journeys around the world. We wish you "bon voyage."

Don't start class without us.

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Science Processes

	Predicting/Inferring	Observing	Classifying	Measuring	Comparing	Collecting/Recording Data	Identifying/Controlling Variables	Interpreting Data	Applying/Generalizing
Surf 'n Sand Count	✓	✓	✓		✓	✓			✓
Surf 'n Sand Spin	✓		✓			✓			✓
Surf 'n Sand Toss	✓					✓			✓
Global AdVENNtures	✓		✓		✓	✓			
Drifting Apart		✓			✓				
Plot Your Position	✓							✓	
Physically Featured					✓			✓	✓
Economically Speaking	✓		✓					✓	
I've Got the World on a String	✓			✓	✓	✓			
South American Jigsaw					✓			✓	
A Patch of North America					✓			✓	
Getting There					✓	✓			
Fire on the Mountain				✓	✓		✓	✓	
The Forecast for Today	✓				✓	✓		✓	✓
People 'Plosion I	✓				✓			✓	
People 'Plosion II	✓				✓	✓			
Count Me In!	✓			✓	✓	✓	✓		
Tic-Tac-Room				✓	✓	✓			
Scale the Room				✓		✓			
Room to Move				✓	✓	✓	✓		
Shrinking Boundaries				✓	✓	✓			
Bird's Eye View						✓	✓	✓	✓
Shop 'Til You Drop				✓	✓	✓		✓	✓
Navigating Numerically					✓	✓		✓	✓
Rallying Around	✓			✓	✓	✓			
What a Relief!		✓		✓		✓			
Mystery Mountain		✓		✓	✓			✓	✓

Math Skills

	Estimating	Measuring	Basic Computation ASMD	Rounding	Finding Averages	Sequencing/Patterning	Using Calculators	Graphing	Using a Protractor	Ratios and Percent	Probability	Plotting Coordinates	Venn Diagrams/Logic	Reading a Compass	Solving Problems	Computing Scale Ratio	Counting/Tallying
Surf 'n Sand Count	✓		✓	✓			✓	✓	✓	✓							✓
Surf 'n Sand Spin			✓	✓				✓	✓	✓	✓	✓					
Surf 'n Sand Toss								✓	✓	✓							✓
Global AdVENNtures													✓				
Drifting Apart															✓		
Plot Your Position	✓											✓					
Physically Featured	✓											✓					
Economically Speaking	✓			✓				✓	✓	✓							
I've Got the World on a String	✓	✓		✓			✓			✓							
South American Jigsaw													✓		✓		
A Patch of North America													✓		✓		
Getting There	✓													✓	✓		
Fire on the Mountain	✓	✓											✓	✓	✓		
The Forecast for Today	✓				✓			✓									
People 'Plosion I	✓		✓	✓		✓	✓	✓									
People 'Plosion II	✓		✓				✓	✓		✓							
Count Me In!		✓	✓		✓												✓
Tic-Tac-Room	✓	✓										✓					
Scale the Room		✓		✓			✓									✓	
Room to Move		✓		✓											✓	✓	
Shrinking Boundaries	✓	✓		✓						✓							
Bird's Eye View		✓													✓		
Shop 'Til You Drop		✓														✓	
Navigating Numerically						✓							✓		✓		
Rallying Around	✓	✓	✓	✓			✓									✓	
What a Relief!		✓															
Mystery Mountain		✓				✓											

Social Science Processes

	Predicting	Locating/Organizing Data	Working Cooperatively	Communicating Ideas	Formulating Questions	Relating to Time/Chronology	Comparing Events/Ideas	Considering Multiple Points of View	Appreciating Rights/Responsibilities	Interpreting Data	Drawing Conclusions	Solving Problems	Making/Reading Maps
Surf 'n Sand Count	✓		✓	✓							✓		✓
Surf 'n Sand Spin	✓		✓	✓							✓		✓
Surf 'n Sand Toss										✓	✓		✓
Global AdVENNtures	✓	✓	✓	✓							✓		✓
Drifting Apart			✓	✓		✓	✓						
Plot Your Position	✓									✓			✓
Physically Featured		✓								✓	✓		✓
Economically Speaking	✓		✓	✓						✓	✓		✓
I've Got the World on a String		✓	✓	✓							✓		✓
South American Jigsaw		✓	✓	✓									✓
A Patch of North America		✓	✓	✓									✓
Getting There			✓	✓	✓								✓
Fire on the Mountain			✓	✓						✓	✓	✓	✓
The Forecast for Today	✓	✓				✓	✓			✓	✓		
People 'Plosion I	✓		✓	✓		✓	✓		✓	✓		✓	✓
People 'Plosion II	✓	✓	✓	✓	✓	✓		✓	✓				
Count Me In!	✓		✓	✓			✓			✓	✓		
Tic-Tac-Room			✓	✓									✓
Scale the Room		✓	✓	✓									✓
Room to Move			✓	✓				✓				✓	✓
Shrinking Boundaries		✓	✓	✓									✓
Bird's Eye View			✓	✓						✓		✓	✓
Shop 'Til You Drop		✓	✓	✓						✓			✓
Navigating Numerically		✓	✓	✓						✓	✓		✓
Rallying Around		✓	✓	✓							✓	✓	✓
What a Relief!		✓	✓	✓									✓
Mystery Mountain			✓	✓						✓	✓		✓

SUPPLY LIST

This list may assist you in assembling the supplies for the activities you have chosen.

CONSUMABLE ITEMS

____ Colored pencils or crayons
____ Tag
____ Large white and colored construction paper
____ Graph paper, size optional
____ Cardboard for map bases
____ Paper fasteners
____ Large paper clips
____ Glue
____ Glue sticks
____ String
____ Newspaper weather reports
____ Two 1 lb. bags of lima beans
____ Masking tape
____ Flour, about 10 pounds
____ Salt, about 10 pounds
____ Gummed labels
____ Toothpicks

NON-CONSUMABLE ITEMS

____ Calculators
____ Protractors
____ Globes, as many as possible
____ 1 beachball globe
____ 5 or more U.S. road maps
____ Sample relief map
____ Scissors
____ Metric rulers
____ Meter sticks
____ Magnetic compasses
____ Drawing compasses
____ Resource books: almanacs, atlases, encyclopedias
____ Mixing containers
____ Measuring cups and spoons
____ Dinner knives
____ Rolling pins

Surf 'n Sand

THIS INVESTIGATION deals with finding the ratio of water to land on the Earth's surface via any one of three activities. In **Surf 'n Sand Count**, squares of land and water will be counted on the world map included. In **Surf 'n Sand Spin**, latitude and longitude will be generated randomly by spinners, the location pinpointed on a map or globe, and a classification of land or water made. In **Surf 'n Sand Toss**, a beach ball globe will be tossed and a record made of land or water under the right index finger of the catcher. The circle graph worksheet can be used to summarize any of the activities. The continents and oceans worksheet may be used as an extension for the **Spin** and **Toss** versions. Choose the activity best suited to your needs or have different groups in the class do the various activities simultaneously and compare their results.

Surf 'n Sand Count

I. Topic Area
Land/Water area of the Earth

II. Introductory Statement
Students will discover the ratio of water to land on the Earth's surfaces by counting squares on a world map.

III. Social Science Processes
Predicting
Drawing conclusions
Working cooperatively
Communicating ideas
Reading maps

Science Processes
Predicting
Observing/Classifying
Comparing
Collecting/Recording data
Generalizing

Math Skills
Estimating area
Counting/Computing
Using calculators
Finding percent
Graphing with a protractor
Rounding

IV. Materials
Worksheets: Surf 'n Sand Count, circle graph
Calculators
Protractors
Colored pencils or crayons
Transparency of map worksheet, optional
Transparency of circle graph, optional
Transparent protractor, optional

V. Key Question
How do the surface areas of land and water on the Earth compare?

VI. Background Information
The Earth's surface is about 71% water and 29% land. See the fact sheet, "Land and Water on the Earth".

A Cylindrical Equal Space Projection is used here, flattening the Earth and putting it on an equally-spaced grid. The land masses near the Poles appear distorted in this type of projection.

When rounding squares that are 50% or more land or water, there will be approximately 60 squares of land and 180 squares of water. When visually estimating the squares the land would cover if compactly joined together in each column, there will be approximately 69 squares of land and 171 squares of water. Using the latter figures, land covers about 29% of the earth and water 71%. Your results may vary due to differences in estimating, but the total number of squares should be 240, the area of the map grid (10 x 24 cm). Even though using such a broad form of estimation, the results are fairly close to the real statistics. If the map grid squares were smaller, the results would be even more accurate.

To construct the circle graph, complete the computation at the top of the second worksheet. Using the latter figures, the rounded results would be:

360 x .29 (land) = 104 degrees
360 x .71 (water) = 256 degrees

VII. Management
1. Teams of two are recommended.
2. It will take about 60 minutes.
3. Land or water which is estimated to cover half or more of any square on the grid will be counted as a whole square for that classification. There is room for disagreement in some columns where the estimation is close, a good point for discussion. The final results will still be very similar. Land masses in a particular column may also be visually estimated according to how many squares they would take up if they were compactly joined together.

VIII. Procedure
Students will:
1. Predict and record the percent of water on the earth's surface.
2. Count and record the number of squares in each column which are half or more land or water. Totals should always equal ten. *Optional view*—Turn the paper sideways and count the long columns.
3. Add the total squares for land and the total squares for water.
4. Find the total area of the map grid and com-

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plete the table by computing or using calculators.

The teacher will:

5. Lead a discussion comparing class results. The columns are labeled with letters for easy reference in case of differences of opinion. Consensus may not always be reached; allow any legitimate estimations. A transparency of the map worksheet is helpful.
6. Give guidance, if needed, in completing the table and in constructing the circle graph. A circle graph transparency and transparent protractor used on the overhead will help less experienced students get started.

Students will:

7. Fill in the number sentences to find the number of degrees which represent each percentage.
8. Construct and label the circle graph.
9. Summarize their information in written form.

IX. Discussion

1. What percent of the Earth's surface is water? (about 71%) How does this compare with your prediction?
2. Were all our results exactly the same? (probably not) Why not? (differences in estimation of area within a square, some squares can be argued for either land or water)
3. A graph title should tell others, in brief form, what the graph represents. What title did you pick? (Example—Surface Area of the Earth) Does it contain too much information? Too little?
4. We've expressed the results in decimals and percents, What other number forms could be used? (ratio: 7:3 water to land; fraction: 7/10 water and 3/10 land)

X. Extensions

1. Compare the area of the four major oceans using the same map grid. Make a table and rank them from largest to smallest.
2. Use the map grid to compare the area of the seven continents and rank them from largest to smallest. Draw the boundary between Europe and Asia.

XI. Curriculum Coordinates

Language Arts/Math: Brainstorm words describing water (liquid, blue, splash, float, molecules, pour...) and land (solid, mud, rock, cracks, molecules, brown...) Are there any words which describe both water and land? Make a Venn diagram with the words that have been collected.

Writing: Prepare an advertisement which will attract creatures from other planets to vacation on the Earth based on the fact that it is largely water.

Art: Color graph paper squares in a ratio of 7 to 3 (like the ratio of water to land) using two colors. The designs could be symmetrical.

Surf 'n Sand Spin

I. Topic Area

Land/Water area of the Earth

II. Introductory Statement

Students will discover the ratio of water to land on the Earth's surface by using spinners to randomly select latitude and longitude, finding the location on a world map, and classifying it as land or water.

III. Social Sciences Processes

Predicting
Working cooperatively
Communicating ideas
Drawing conclusions
Reading maps

Science Processes

Predicting
Classifying
Collecting/Recording data
Generalizing

Math Skills

Using probability
Plotting coordinates
Computing
Finding percent
Rounding
Graphing with a protractor

IV. Materials

Worksheets: Surf 'n Sand Spin, circle graph
Per group: 1 sheet of tag or a manila folder
2 large paper fasteners
2 large paper clips
1 or more globes or world maps with latitude and longitude markings (history textbook, atlas, etc.)
Protractors
Colored pencils or crayons

V. Key Question

How do the surface areas of land and water on the Earth compare?

VI. Background Information

The Earth is about 71% water and 29% land. The use of spinners to determine random latitude and longitude readings sets up a probability experiment that, if repeated a sufficiently large number of times, should result in numbers fairly close to the actual percentages. See the fact sheet, "Land and Water on the Earth".

VII. Management

1. Groups of four are recommended—a spinner, at least two map readers, and a recorder. It is important to cross-check latitude/longitude locations. Each map reader should have their own map; encourage the use of different kinds within the group.
2. The worksheet is set up for two sets of ten trials. If locating latitude and longitude is a difficult skill, one set of ten trials may be used per group. However, more trials yield greater accuracy in the final results.

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3. The spinners should be prepared according to the directions before beginning the activity. Using the top of a manila folder for the spinners makes it easy to organize group worksheets inside.
4. Students may round their spins to the nearest five degrees. If more specialized practice is desired, they may estimate to the nearest degree. Set a standard before starting.

VIII. Procedure

Students will:

1. Predict the percent of water on the Earth's surface.
2. Spin both spinners, estimate and record the latitude and longitude readings with hemisphere abbreviations (Example: 45 N°, 30° W).
3. Find the latitude/longitude location on a map and record whether it is on land or in water.
4. Total the number on land and in water and report to the class.
5. Record each group's totals in Class Results and find the grand total. Add the grand totals to get the total number of spins.
6. Figure the percent of land and water using the bottom table. Ratio is written as the number of land counted over total spins and the number of water counted over total spins.
7. Fill in the number sentences to find the number of degrees which represent each percentage.
8. Construct and label the circle graph.
9. Summarize their information.

IX. Discussion

1. What percent of the Earth's surface is water? (about 71%) How does this compare with your prediction?
2. How close were our results to the actual facts? What factors might cause differences? (spinners not constructed to move freely or without bias and, therefore, not truly random; errors in map reading; not enough trials; etc.)
3. A graph title should tell others, in brief form, what the graph represents. What title did you pick? Does it contain too much information? Too little?

X. Extensions

Do the activity included for comparing the areas of the various oceans and continents.

XI. Curriculum Coordinates

See *Surf 'n Sand Count* for suggestions.

Surf 'n Sand Toss

I. Topic Area

Land/Water area of the Earth

II. Introductory Statement

Students will discover the ratio of water to land on the Earth's surface by tossing a beachball globe repeatedly and recording whether the right index finger touches land or water.

III. Social Science Processes

Interpreting data
Drawing conclusions
Reading maps

Science Processes

Collecting/Organizing data
Making inferences
Generalizing
Applying

Math Skills

Tallying
Setting up ratios
Finding percent
Graphing with a protractor

IV. Materials

Worksheets: Surf 'n Sand Toss, circle graph
Beach ball globe (available in toy stores)

V. Key Question

If a beach ball globe is tossed and caught, what percent of the time will the catcher's right index finger be on water? On land?

VI. Background Information

The Earth is covered by huge amounts of water. Over seventy percent of the Earth's surface is water, leaving less than thirty percent for land. In this activity the percentages will be calculated by doing a probability experiment in which a globe is repeatedly tossed and caught. With a sufficiently large number of tosses, the result of the probability experiment should come out fairly close to the actual percentages. See the fact sheet, "Land and Water on the Earth".

VII. Management

This activity should be done with the whole class. You may want to make some rules about how to toss and catch the ball. Spin the globe as it is tossed to insure randomness. Each student can make an individual tally as the ball is thrown or one person can make a tally on the board and the students can fill in the results after the three trials are done.

VIII. Procedure

The teacher will:

1. Discuss the key question.
2. Discuss the rules for tossing and catching the globe, and decide how the tallying will be done.

The students will:

3. Toss and catch the ball 50 times and keep a tally in the space for Trial 1. Use this information to fill in the percent table.
4. Repeat the process for Trials 2 and 3.
5. Find the average percent of land and water calculated from this activity.
6. Fill in the number sentences to find the number of degrees which represent each percentage.
7. Construct and label the circle graph.
8. Summarize their information and discuss.

IX. Discussion

1. What did you prove by doing this activity?
2. What factors could have affected the outcome?
3. If you were to get one toss and catch, where would you predict your finger would land?

X. Extension

Keep track of the ocean or continent on which your finger lands and calculate the percent of the water or land mass of each, using the activity sheet included.

XI. Curriculum Coordinates

See *Surf 'n Sand Count* for suggestions.

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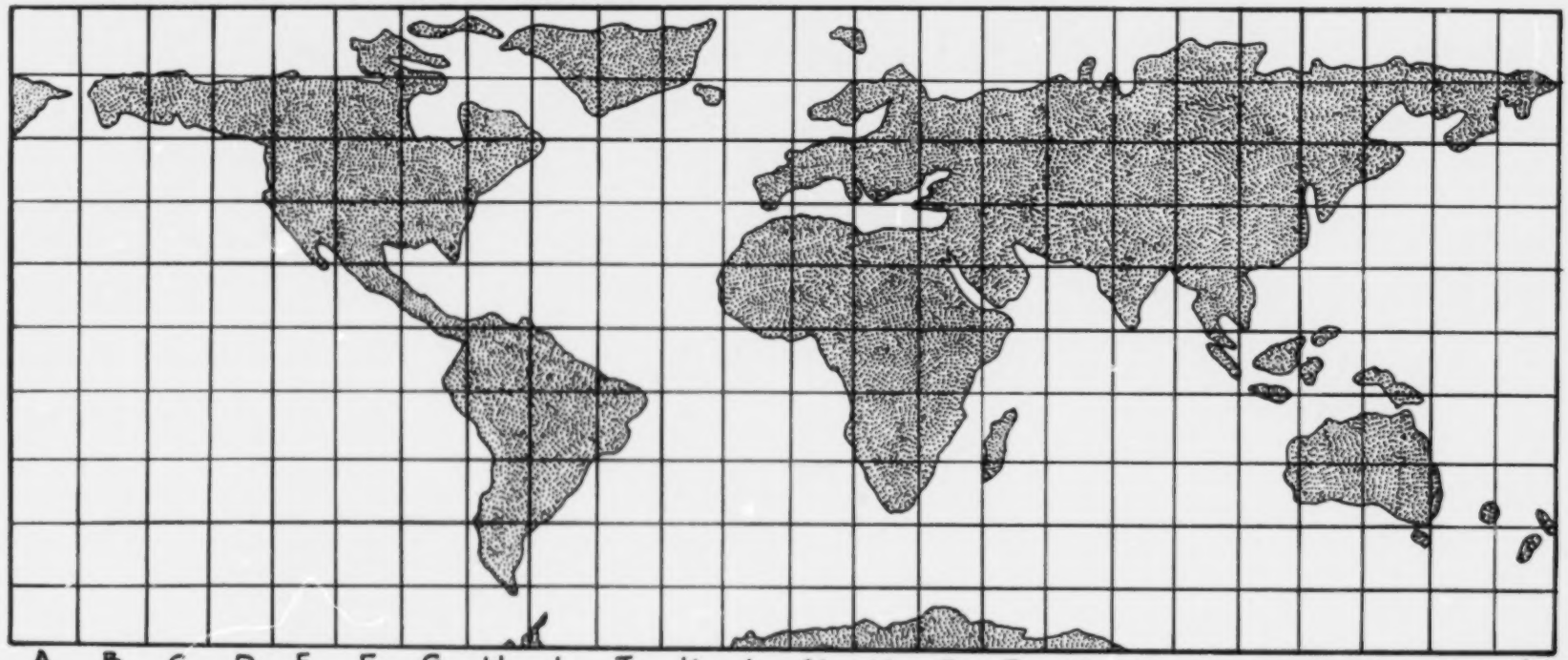
Surf 'n Sand Count

Names _____

PREDICT WHAT PERCENT OF THE EARTH'S SURFACE IS WATER._____(0-100)

Count the number of squares of land and water in each column.

CYLINDRICAL EQUAL SPACE PROJECTION



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	TOTALS
LAND																									
WATER																									

TOTAL AREA OF MAP GRID IN CM

_____ x _____ = _____

	RATIO $\frac{\text{sq. Count}}{\text{total area}}$	DECIMAL	PERCENT (decimal x 100)
LAND			
WATER			

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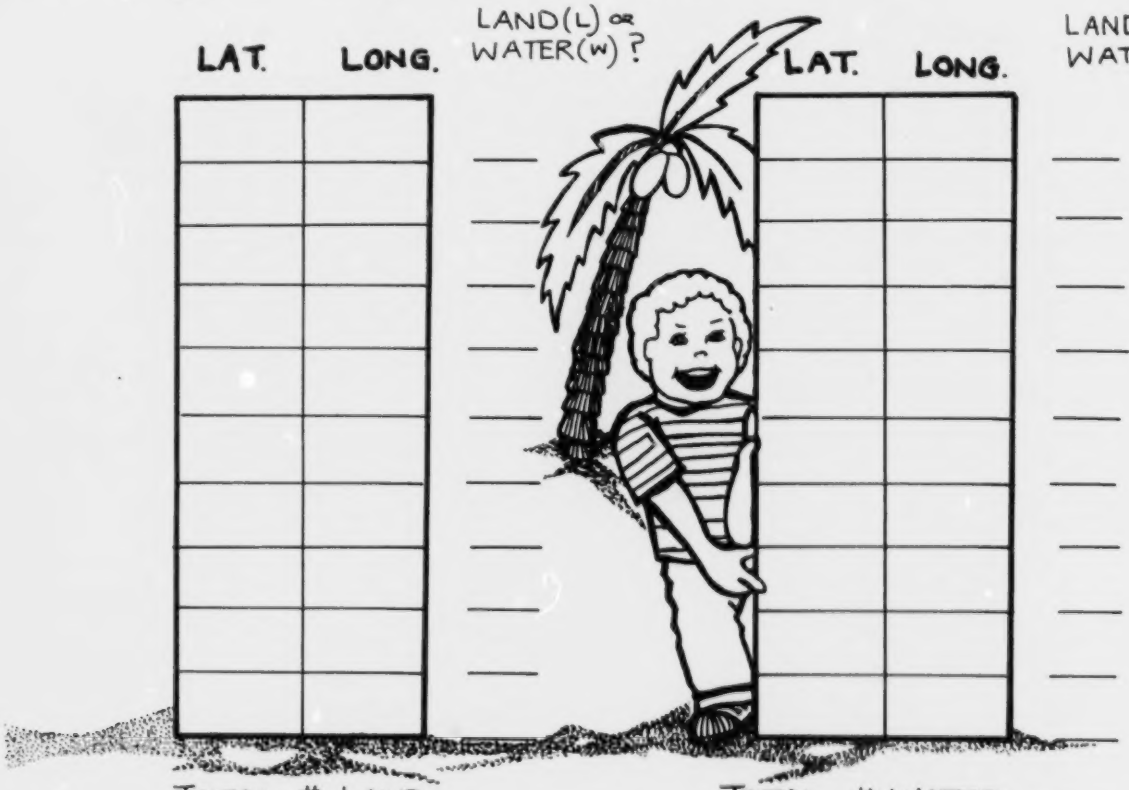
Surf 'n Sand Spin

Names

Predict the percent of water on the Earth's surface. _____ (0–100)

Spin for latitude and longitude. Record the degrees and locate on a map or globe. Complete the tables.

LAT.	LONG.	LAND (L) OR WATER (W)?



LAT.	LONG.	LAND (L) OR WATER (W)?

TOTAL # LAND _____ TOTAL # WATER _____

CLASS RESULTS

GROUP	A	B	C	D	E	F	G	H	I	J	GRAND TOTAL
# LAND											
# WATER											

_____ TOTAL SPINS

	RATIO # counted / total spins	DECIMAL	PERCENT (decimal x 100)
LAND			
WATER			

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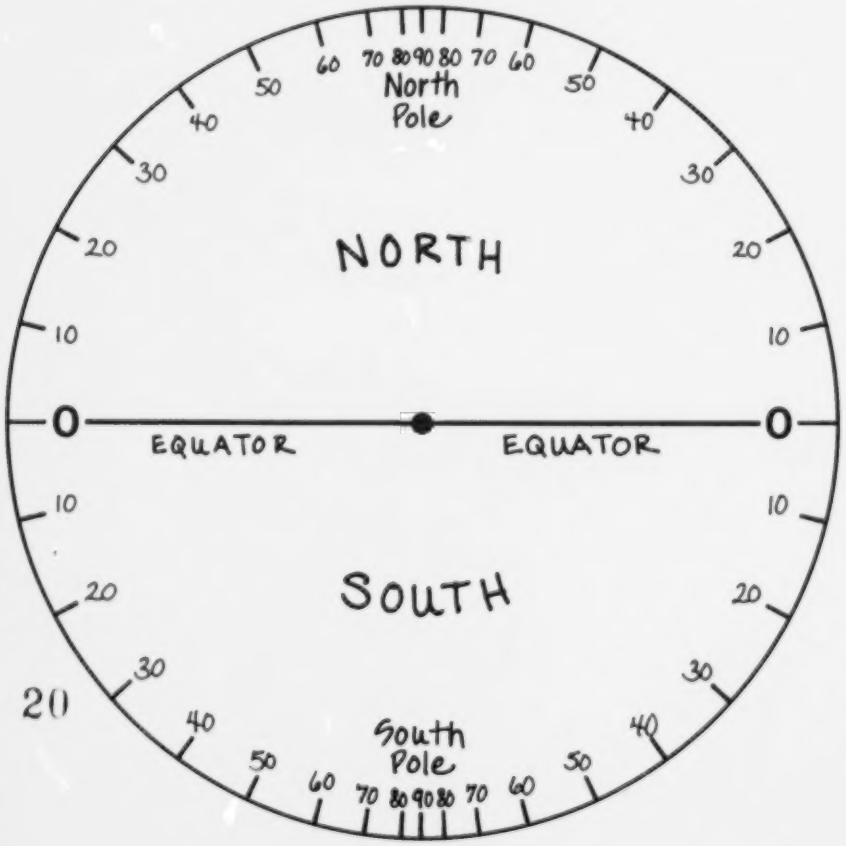
Surf 'n Sand Spin...

Mount on tag or a manila folder. Insert a paper fastener in each center with a large paper clip attached. Wrap a thin piece of tape around the tip of the paper clip and cut to make an arrow.

LATITUDE



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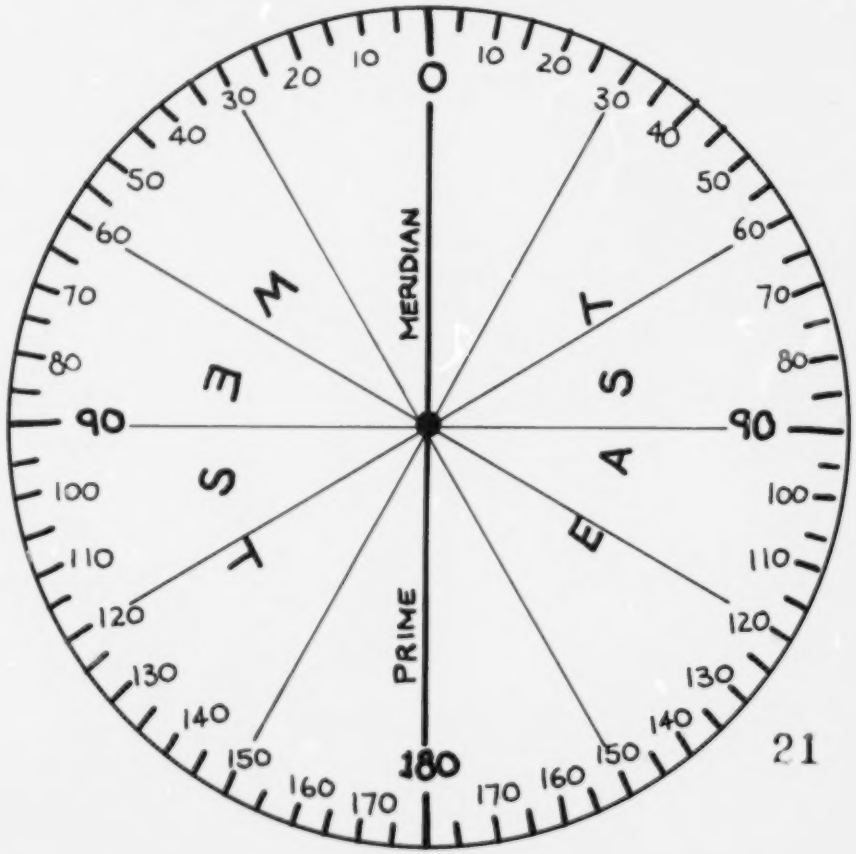
LONGITUDE



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Surf 'n Sand

Name _____

CIRCLE GRAPH

Total degrees in circle	Decimal	# of degrees representing area

_____ X _____ (land) = _____

_____ X _____ (water) = _____

Use a protractor to construct a circle graph showing your data. Label and color the graph. Give it a title.

_____

_____

Summarize your data: _____

_____

_____

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Name _____

Surf 'n Sand Toss

If a beach ball globe is tossed and caught, what percent of the time will the catcher's right index finger be on water?

Do three trials in which the globe is tossed and caught 50 times. Keep a tally of the results in the first table and then calculate the percents in the second table.

Tally

Trial	Land	Water
1		
2		
3		

Percents

Trial	Land/Total	Percent Land	Water/Total	Percent Water
1				
2				
3				
	Average		Average	

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Surf 'n Sand Count

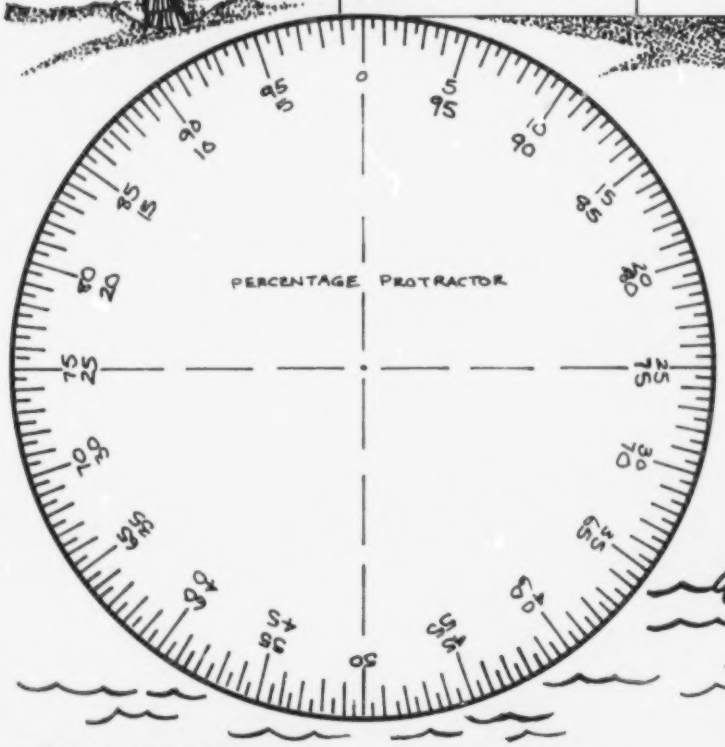
SPIN OR TOSS

Name _____

How does the surface area of each ocean and continent compare?

Taking 100 spins or tosses, tally the number of times you land in each ocean or continent.

	TALLY	RATIO	%
ARCTIC			
ATLANTIC			
INDIAN			
PACIFIC			
AFRICA			
ANTARCTICA			
ASIA			
AUSTRALIA			
EUROPE			
NORTH AMERICA			
SOUTH AMERICA			
		TOTAL	



Graph the percents. Label and color.

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LAND AND WATER ON THE EARTH

The Earth covers a surface of about 317,100,000 square kilometers (197,000,000 sq. miles). Approximately 71% of this surface is water and 29% is land. About 60% of the Northern Hemisphere is covered by water; in the Southern Hemisphere it is about 80%. The world's oceans have an average mean depth of 3,729 meters (12,234 ft.). The deepest place in the ocean is a V-shaped groove called the Mariana Trench (11,033m or 36,198ft.); it is located in the Pacific Ocean.

Though the Earth's oceans are really part of one continuous body of water, geographers have defined the oceans' boundaries. The Pacific and Atlantic are divided by the meridian straight south from Cape Horn, the Atlantic and Indian by one south from the Cape of Good Hope, and the Indian and Pacific by one south from Australia and through Tasmania. The Arctic Ocean is bounded mostly by land around the Arctic Circle.

OCEAN	AREA in sq. km	(sq. miles)	% OF EARTH'S SURFACE
Pacific	112,700,000	(70,000,000)	35.5%
Atlantic	58,600,000	(36,400,000)	18.5%
Indian	46,000,000	(28,600,000)	14.5%
Arctic	7,600,000	(4,700,000)	2.4%
	224,900,000	(139,700,000)	70.9%

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LAND AND WATER ON THE EARTH

The Northern Hemisphere contains more than two thirds of the Earth's land surface. All of the continents except Antarctica are wider in the north than in the south, giving them a wedge-shaped appearance. Europe is the only continent without a more or less separate land mass; it is really a peninsula of Asia and sometimes these two continents together are called Eurasia.

CONTINENT	AREA in sq. km	(sq. miles)	% OF EARTH'S SURFACE
Asia	27,500,000	(17,100,000)	8.7%
Africa	19,000,000	(11,800,000)	6.0%
North America	13,700,000	(8,500,000)	4.3%
South America	11,100,000	(6,900,000)	3.5%
Antarctica	9,700,000	(6,000,000)	3.1%
Europe	6,400,000	(4,000,000)	2.0%
Australia	4,800,000	(3,000,000)	1.5%
	92,200,000	(57,300,000)	29.1%

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Global AdVENNtures

I. Topic Area
Hemispheres/Continents and Oceans

II. Introductory Statement
Students will determine the hemispheric locations of the seven continents and four major oceans, using a Venn diagram to illustrate their findings.

III. Social Science Processes
Hypothesizing
Locating/Organizing data
Drawing conclusions
Working cooperatively
Communicating ideas
Reading Maps

Science Processes
Predicting
Classifying
Comparing
Recording data

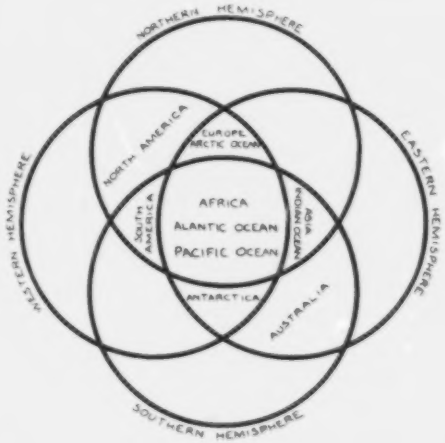
Math Skills
Using Venn diagrams

IV. Materials
Worksheets
Globes or world maps with latitude/longitude lines

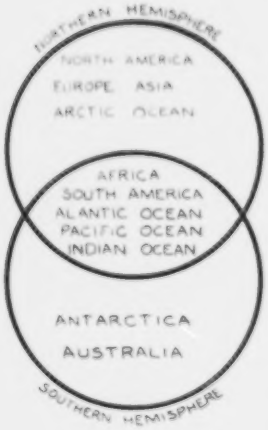
V. Key Question
Which continents and/or oceans touch all four hemispheres?

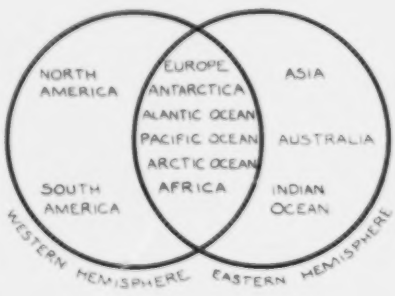
VI. Background Information
Venn diagrams are one form of logical thinking. They are a useful way to compare and contrast two or more attributes. In this activity, the attributes are the four possible hemispheres into which the world can be divided. Since a hemisphere is half of a sphere, two hemispheres are compared at a time. Continents and oceans which are in both hemispheres should be written in the intersection of the two circles. It should be noted that Asia includes Indonesia and should be recorded accordingly.

The same information can be placed into four intersecting circles, a more difficult feat. It is helpful to label the intersecting spaces on the Venn diagram with the combination of hemisphere initials (N, S, W, or E) each represents. An additional option is to use colored pencils to shade in all the two-hemisphere intersections with one color, the three-hemisphere intersections with another color, and the four-hemisphere intersections with a different color. Then write the results.



The Goode's Equal Area Projection, one of the maps included in the atlas, is a special map which is drawn on a flat surface but illustrates that the Earth is round. The Equator divides the Earth into Northern and Southern Hemispheres, while the Prime Meridian (0 degrees longitude) and International Date Line (mostly at 180 degrees longitude) divide the Earth into Eastern and Western Hemispheres. The Prime Meridian runs through the original site of the Royal Observatory in Greenwich, England, a few kilometers from London. The International Date Line, on the opposite side of the world, is the place where each calendar day begins.





VII. Management
1. Globes are preferable to maps. Borrow enough from other classrooms so that each group has one. If this is not possible, use one of the maps at the end of the book.
2. Groups of two to four are suggested.

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3. Acquaint students with terms such as hemisphere, longitude, latitude, Equator, and Prime Meridian prior to doing this activity.
4. Decide which Venn diagram(s) are appropriate for the class:
   a. Two circles comparing the Northern/Southern Hemispheres and two circles comparing the Western/Eastern Hemispheres;
   b. Four circles comparing all the hemispheres;
   c. All of the above
5. It may be helpful to have students organize the data for the 4-circle Venn into a table with the following headings: NW, NWE, NE, NSE, SE, SWE, SW, NSW, and NSEW.
6. Allow two or more 45 minute periods, depending on the options chosen.
7. Guide students according to the extent of their experience with Venn diagrams. Transparencies are helpful.

VIII. Procedure

1. Ask the key question and have students predict the answer without the use of a map. "None" is a possible prediction.
2. Have students use a globe or world map to complete parts 2 and 3. If using the map included, students should label the continents, oceans, Equator, and Prime Meridian first. Group roles may be assigned or students can take turns classifying the continents and oceans. Give guidance where needed.
3. If the Goode's Projection is used, explain its purpose.
4. On the second day, have students label and complete the chosen Venn diagrams. It may be necessary to help them get started. If doing all three diagrams, an extra day may be needed.
5. Have students answer part 4.
6. Lead a class discussion.

IX. Discussion

1. What continents and/or oceans are in all four hemispheres? (Africa, Atlantic Ocean, Pacific Ocean)
2. What line divides the Northern and Southern Hemispheres? (Equator) Where is it located? (0° latitude)
3. What lines divide the Eastern and Western Hemispheres? (Prime Meridian, International Date Line) Where are they located? (PM—0° longitude, IDL—180° longitude)
4. On the four-circle Venn diagram, why are there no listings on the outside or non-intersecting spaces? (Every continent and ocean has a North/South location as well as an East/West location; they can't be in just one hemisphere.)
5. What are some examples of two ideas or events that can be compared by organizing them into a Venn diagram? (the views of two presidential candidates, the positive points of two prospective universities, etc.)

X. Extensions

1. Since there is no listing for the Southern/Western category in the 4-circle Venn, challenge students to find some islands which would qualify for that section (*Examples:* South Sandwich Islands, Falkland Island in the Atlantic Ocean; Pitcairn Island, Tahiti, Cook Island in the Pacific Ocean).
2. Find islands in the Northern/Eastern category as above.
3. Comparing North/South and then East/West, which hemisphere appears to have the most land? (Northern, Eastern) Most water? (Southern, Western)
4. Use Venn diagrams to show the overlapping of the interests or hobbies of four friends.
5. Do other Venn diagram activities such as "Can You Planet?" from the AIMS book, *Out of This World*.

XI. Curriculum Coordinates

Language Arts

1. Given an essay assignment comparing and contrasting two concepts, two literary characters, etc., students can use a Venn diagram to organize their thoughts or research.

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Global AdVENNtures

Explorers _____

_____

_____

_____

1. Predict by circling the continents and/or oceans which touch all four hemispheres:

NORTH AMERICA SOUTH AMERICA EUROPE ASIA AFRICA AUSTRALIA ANTARCTICA

PACIFIC OCEAN ATLANTIC OCEAN ARCTIC OCEAN INDIAN OCEAN

2. Use a globe or map to classify the continents and oceans listed above according to their locations in the Northern and Southern Hemispheres.

NORTHERN HEMISPHERE ONLY	BOTH HEMISPHERES	SOUTHERN HEMISPHERE ONLY

3. Classify the continents and oceans by Eastern and Western Hemispheres.

WESTERN HEMISPHERE ONLY	BOTH HEMISPHERES	EASTERN HEMISPHERE ONLY

29

30

4. Which continents and/or oceans touch all four hemispheres?

_____

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Explorer _____

Global AdVENNtures

LABEL THE HEMISPHERES.

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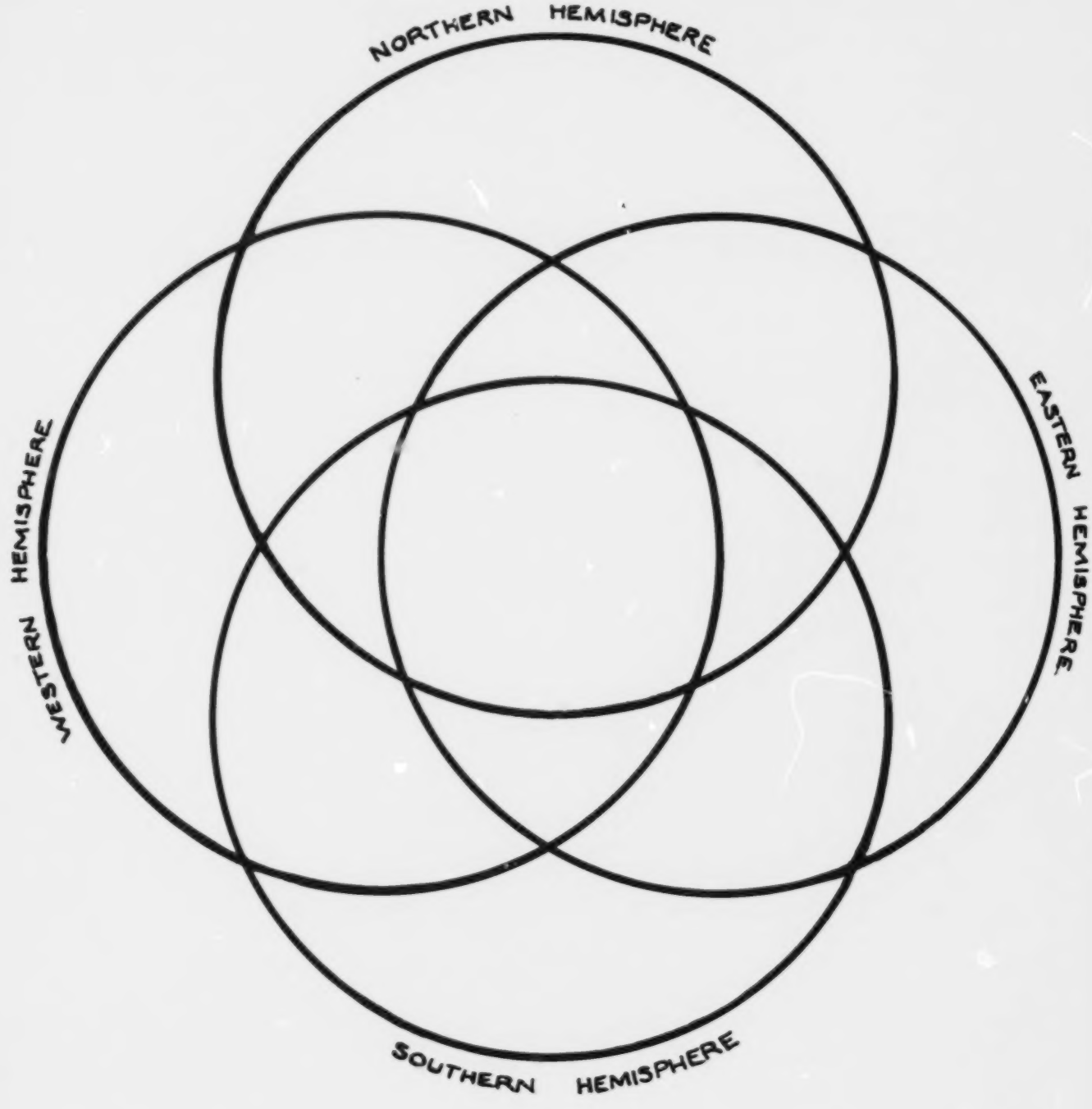
Explorers

Global AdVENNtures



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DRIFTING APART

I. Topic Area
Continental drift theory

II. Introductory Statement
Students will use a jigsaw puzzle format to determine how the continents may have at one time fit together.

III. Social Science Processes
Relating to time
Comparing events
Working cooperatively
Communicating ideas

Science Processes
Observing
Comparing

Math Skills
Problem solving

IV. Materials
Worksheet
Fact sheet, "Continental Drift Theory"
Scissors
Scraps of cloth or unbleached muslin, optional
Cut transparency of land masses, optional
Standard size blank paper, optional
Glue, optional

V. Key Question
How might the land on Earth have once been joined together as one supercontinent?

VI. Background Information
See the fact sheet for information on the theory of continental drift. When first introduced in 1912, it was rejected. Since the 1960's, accumulating evidence and new explanations of why it might have happened have won over many scientists. However, it is still a theory.

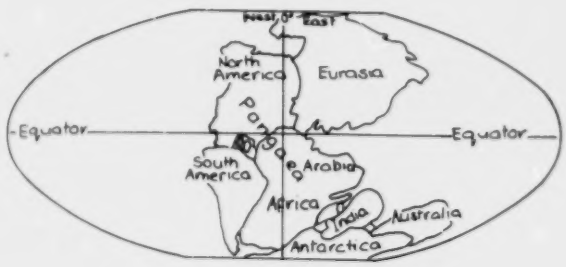
The significance of this theory is that it helps us 1) understand earthquakes and volcanoes and 2) understand the way mineral resources are distributed.

The possible joining of the continents would have happened along the edges of the continental shelves, not the shorelines. The shorelines have changed due to variable water levels and the growth of new formations over millions of years. Maps of the continental shelves are not common so the standard continental shapes have been taken from a globe and generalized for this activity. Therefore, the fit will not be as close.

The actual continent to continent fit that may have made up Pangaea is described as a part of Procedure. *A word of caution:* The evidence most strongly supports the position of South America adjoining western Africa. The other continental positions do not have as much documentation and, therefore, maps in various sources may differ somewhat. One version is included in the fact sheet. Millions of years ago, India was separate from Asia and is represented that way on the worksheet.

VII. Management
1. Partners are recommended for this activity.
2. A cut out transparency of the worksheet can help illustrate the position of the land masses in Pangaea.
3. Because the Earth is spherical in shape, it is impossible to give an accurate representation of the continents on a flat surface. To minimize this distortion, you may wish to have students trace the shapes onto a piece of cloth (about the size of two standard pieces of paper) and use these in their reconstruction of Pangaea.

VIII. Procedure
Students will:
1. Finish labeling and cut out the land masses on the worksheet. Using a world map, place a compass rose on each piece to compare the present orientation with the positions when Pangaea may have existed.
2. Be given a specified amount of time, 5 to 10 minutes, to explore how the supercontinent may have fit together.
3. Follow directions from the teacher for placing the land masses in the positions suggested by the continental drift theory. A transparency of the land masses may be used to give visual assistance.



DIRECTIONS FOR PANGAEA

a. Place the eastern edge of South America against the lower western half of Africa.
b. Move the eastern coast of North America so that it touches the northwestern side of Africa.
c. Set southern Eurasia so that it joins North America and northern Africa. (The exact position varies with the source.)

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d. Sandwich Greenland between North America and Eurasia.
e. Position western India against eastern Africa.
f. Place western Australia next to eastern India.
g. Connect eastern Antarctica with southern Australia.
h. Join Antarctica with southern Africa.

---

4. Glue the pieces in place on another sheet of paper (optional).
5. Review the information on the fact sheet.

IX. Discussion

1. Do you think Pangaea once existed? Why or why not?
2. In which direction is each of the continents moving?

X. Extensions

1. Study a map of the ocean floors. Trace the mid-ocean ridge and the connecting mountains as they wind continuously through the world. Notice that all the ocean waters are joined.
2. Compare maps of the earthquake areas, volcanic belts, and the Earth's plates. How are they related?
3. Based on the movement of the continents, make predictions of how the Earth will look 300 million years from now.

XI. Curriculum Coordinates

Language Arts:

1. Write a biography of Wegener and trace the developments leading to his theory of the continental drift.
2. Research the developments in the 1960's which led to the idea of plate tectonics. Pretend you are a reporter for *Scientific American Magazine*, and write an article explaining the "who, what, when, where, why, and how" of these developments.

Science:

1. Do activities from this K-6 resource on earthquakes: NSTA/FEMA, "Earthquakes", ISBN 0-87355-082-X. Order from:

   The National Science Teachers Association
   1742 Connecticut Avenue, N.W.
   Washington, DC 20009

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DRIFTING APART

Finish labeling these major land masses and cut them out.
Mark North on each piece.

How might these pieces have fit together as one supercontinent?

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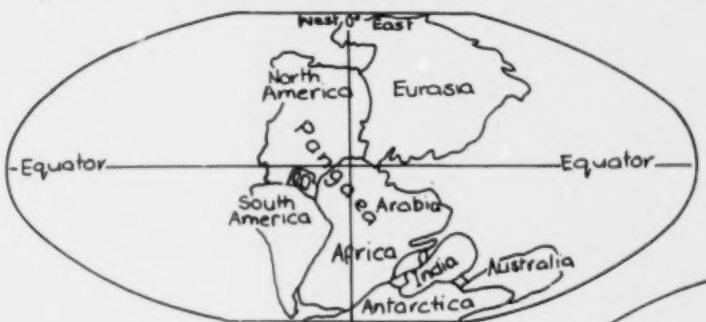
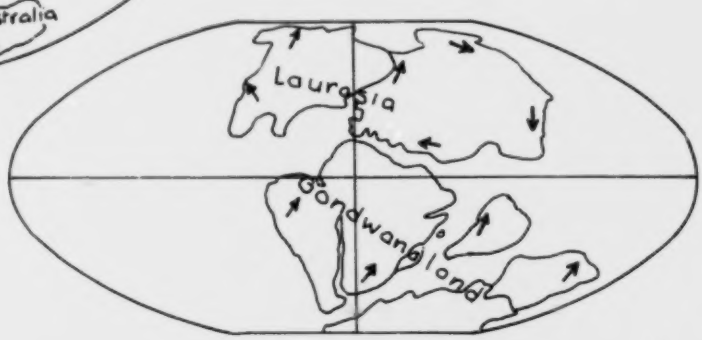
Continental Drift Theory

A Pioneer

In 1912 the German meteorologist and explorer, Alfred Wegener, presented the theory that the continents were once joined together in one big land mass and have, over millions of years, slowly drifted apart into their present positions. He named this supercontinent Pangaea, a Greek word meaning "all land." The rest of the Earth's surface was covered with a massive ocean called Panthalassa. Over time, Pangaea split into two subcontinents. Laurasia in the north contained present-day Asia, Europe, and North America. Gondwanaland in the south included South America, Africa, India (then separate from Asia), Australia, and Antarctica.





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His theory was fiercely rejected at that time. What did a meteorologist, an outsider, know about geology? Since the 1960's, the theory has gained general acceptance among scientists.

Alfred Wegener was born in Berlin on Nov. 1, 1880. He studied astronomy and meteorology, receiving his doctorate in 1904. As a teacher, he inspired enthusiasm and strong loyalty. He authored a meteorology textbook which was used throughout Germany.

Wegener wondered, "Why should tropical ferns have grown in London, Paris, and even Greenland, yet glaciers have covered Brazil and the Congo at the same time?" He collected evidence from rocks, fossils, and the climate of the various continents to show they had once been joined together.

Ancient mountain systems, called cratons, show a connection between continents. Rocks in Africa and South America are of the same age and type; the diamond fields of South Africa and Brazil are an example. Supporting evidence also comes from the distribution of ancient and living organisms. Fossils of similar land animals have been found by paleontologists in the rocks of Asia, Europe, and North America. A change in the position of the continents would also explain why plants similar to those in tropical areas once grew in Greenland and glaciers once covered the equatorial regions of Africa and Brazil.

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The Structure of the Earth

The Earth has three layers: the crust, the mantle, and the core. The Earth's crust is about 10 kilometers thick on the ocean floor and 32-72 kilometers thick on the continents, depending on elevation. The oldest rocks in the crust are about 3.8 billion years old, as measured by radiocarbon dating. The most predominant topographical feature of the Earth's crust is the mid-ocean ridge, part of a 75,000 kilometer long mountain range that curls through all the oceans of the world like the seam on a baseball.

Sea Spreading

In the 1960's, sea spreading was advanced as an explanation for the movement of the land. It was shown that the ocean floor is spreading apart at the mid-ocean ridges, about one centimeter per year on each side of the ridge. Molten rock comes up through large cracks in the ocean ridges, cools, and slowly pushes the ocean floor and continents away from the ridges. The size of the Earth is not changing, so if it is growing at the ridges, it must be shrinking somewhere else. Plate tectonics and convection currents offer a possible explanation.

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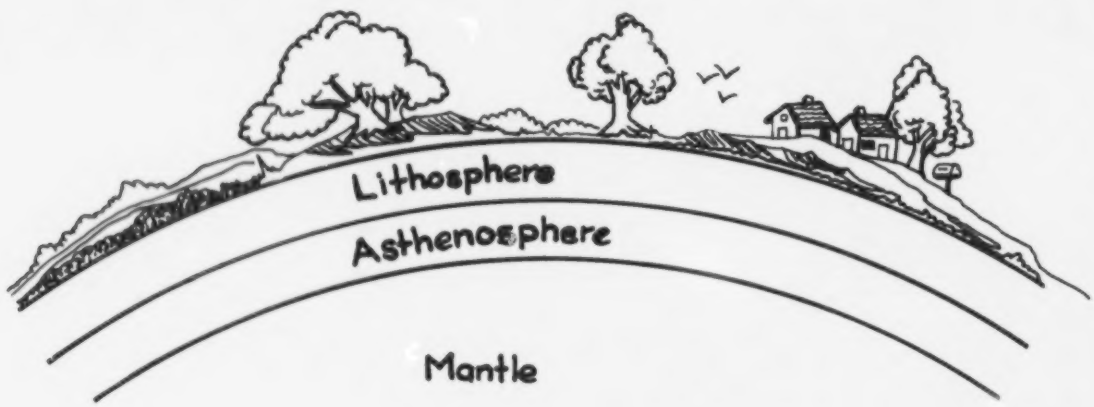
Plate Tectonics

The crust and upper part of the mantle are called the lithosphere or rock sphere. Below it lies the asthenosphere, a soft, semisolid layer of rock which flows plastically due to high temperatures and tremendous pressures.



According to an explanation developed in 1968 called plate tectonics, the Earth's crust is split into seven to twelve major plates and several smaller ones. These strong, rigid plates float on the asthenosphere. Most take their names from the continent, ocean, or area they cover. The plates move by spreading apart, sliding, or colliding. Earthquakes and volcanic eruptions take place along the edges of these plates. They move 2-15 centimeters a year, about the rate your fingernails grow.

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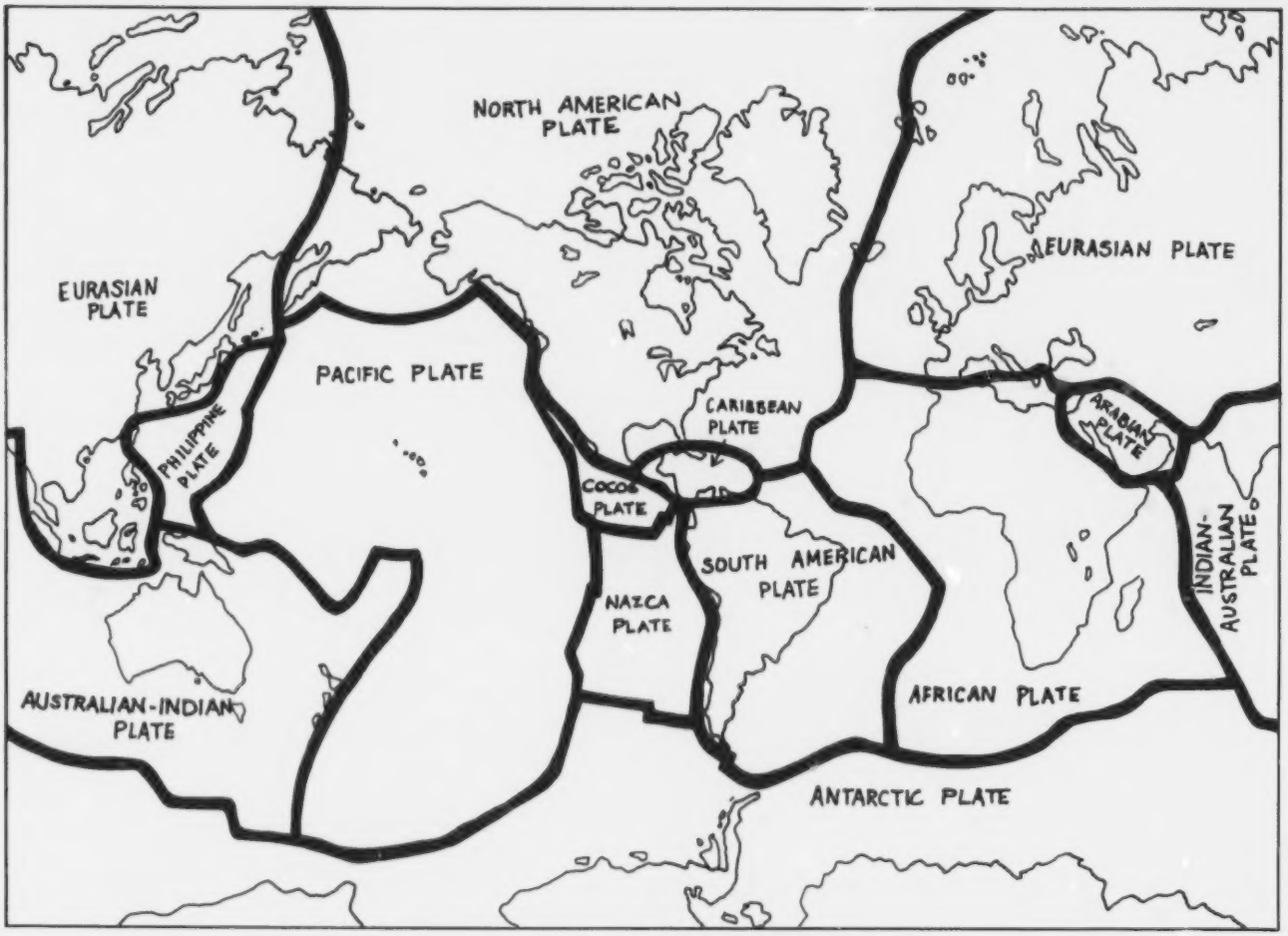

What drives the movement of the plates? Wegener thought it was centrifugal force caused by the Earth's rotation. Scientists now favor convection currents, systems of heat exchange, as an explanation. The semi-molten asthenosphere rises with heat, causing the plates to separate, and sinks as the temperature drops, causing the plates to collide. Sometimes the edge of a plate slides under another one (subduction); pieces break off and are melted by the high temperatures. The molten material feeds volcanoes. This shrinking at the edges of the plates balances the growth at the ocean ridges.

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PLOT Your Position

I. Topic Area
Longitude and latitude

II. Introductory Statement
Students will plot the boundaries of a fictitious country using coordinate points of latitude and longitude.

III. Social Science Processes
Predicting
Making/Reading maps
Interpreting data

Science Processes
Predicting/Inferring
Interpreting data

Math Skills
Plotting coordinates
Estimating

IV. Materials
Practice worksheets (A easier, B harder)
Mapping worksheets
Mapping grid
Transparency of grid, optional
Rulers
World map

V. Key Question
A new country has just been discovered. Where in the world is it?

VI. Background Information
The Northern and Southern Hemispheres are divided by the Equator. Lines north of the Equator are northern latitudes. Lines south of the Equator are southern latitudes.

The following three activities—**Plot Your Position, Physically Featured,** and **Economically Speaking**—are a series based on the same fictitious country. Each one builds on the previous work. However, materials are included so that any one activity may be done independently of the others.

The Eastern and Western Hemispheres are divided by the Prime Meridian. The 180 degree longitudinal line, which defines much of the International Date Line, continues this division around the world. Lines east of the Prime Meridian are eastern longitudes. Lines west of the Prime Meridian are western longitudes.

In plotting points on x and y axes, points along the x-axis are plotted first. In plotting positions on a map, lines of latitude are always given first. Lines of latitude are comparable to the y-axis. Lines of longitude are comparable to the x-axis. Students who are used to plotting on x and y axes may experience some confusion since they must plot latitude first (y) and longitude second (x).

For convenience, a flat grid has been provided with equal space between each latitude and each longitude line. In actuality, longitude lines are not equidistant. See the fact sheet.

VII. Management
1. This activity will require:
   a. One 30-minute session to review the concepts of latitude, longitude, Equator, Prime Meridian, hemispheres, direction, and cartography (map making).
   b. One 45-minute session for the practice lesson, if needed.
   c. One 45-minute session for the map grid.
2. In the actual lesson, don't pass out the mapping grid until students have made predictions on the worksheet; the grid gives visual clues to the location of the fictitious country.
3. Some experience with x and y plotting might be helpful.
4. Check, using the maps in *Physically Featured.*

VIII. Procedure
1. If practice is needed in plotting points, do the practice lesson most appropriate for the class.
2. In the actual lesson, pass out the worksheet first. Have students make their predictions before passing out the mapping grid.

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3. Pass out the mapping grid and allow students to plot latitudinal and longitudinal points independently. It may be helpful to plot the first few points on an overhead transparency to get them started.
4. Have students number each point as they plot it and connect all points in order with a ruler.
5. Upon completion, use a world map to see exactly where this fictitious country would lie if it existed.
6. After points have been plotted, have students cover the list of points with their map. Call out point numbers and have students give ordered pairs orally for reinforcement.

IX. Discussion

1. Does everyone have a country that is shaped exactly the same?
2. In which hemispheres does this fictitious country lie? (Southern, Western)
3. Which ocean surrounds this country? (Atlantic)
4. What is the nearest existing continent? (South America)
5. What clues in the list of points help you establish this country's location in relation to the rest of the world? (directions, the distance of the numbers from 0 degrees latitude or longitude)
6. What is another word for 0° latitude? (Equator); for 0° longitude? (Prime Meridian)
7. Is it possible to live in more than one hemisphere at a time? (Yes. We all live in at least two: Northern or Southern and Eastern or Western.)

X. Extensions

1. On a large world map, plot the points so students can visualize the location of the fictitious country in relation to the rest of the world.
2. Have students research information about the Tropic of Cancer and the Tropic of Capricorn.
3. Discuss who might have discovered this country, what kind of people might live there, and what language might be spoken.
4. Make up a name for the country.
5. Find the latitude and longitude for the city or town where you are now. What other cities or towns lie along the same lines?
6. Use road maps to demonstrate another way to find positions on maps (A-3, etc.). This will show students a practical use for knowing how to plot points.
7. Do the follow-up activities, *Physically Featured* and *Economically Speaking*.

XI. Curriculum Coordinates

Language Arts: Write a news article, "New Country Discovered by _____!"

Math: Use a protractor to find the interior and exterior angles at the coordinate points.

Computer: Having measured the angles, use Logo to create the country on the computer.

Science: Discuss climatic differences in the Southern Hemisphere. Why are the seasons opposite to the seasons in the Northern Hemisphere?

Art: The practice worksheet creates symmetrical patterns. Cut out or draw symmetrical pictures.

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PLOT Your Position

CARTOGRAPHER

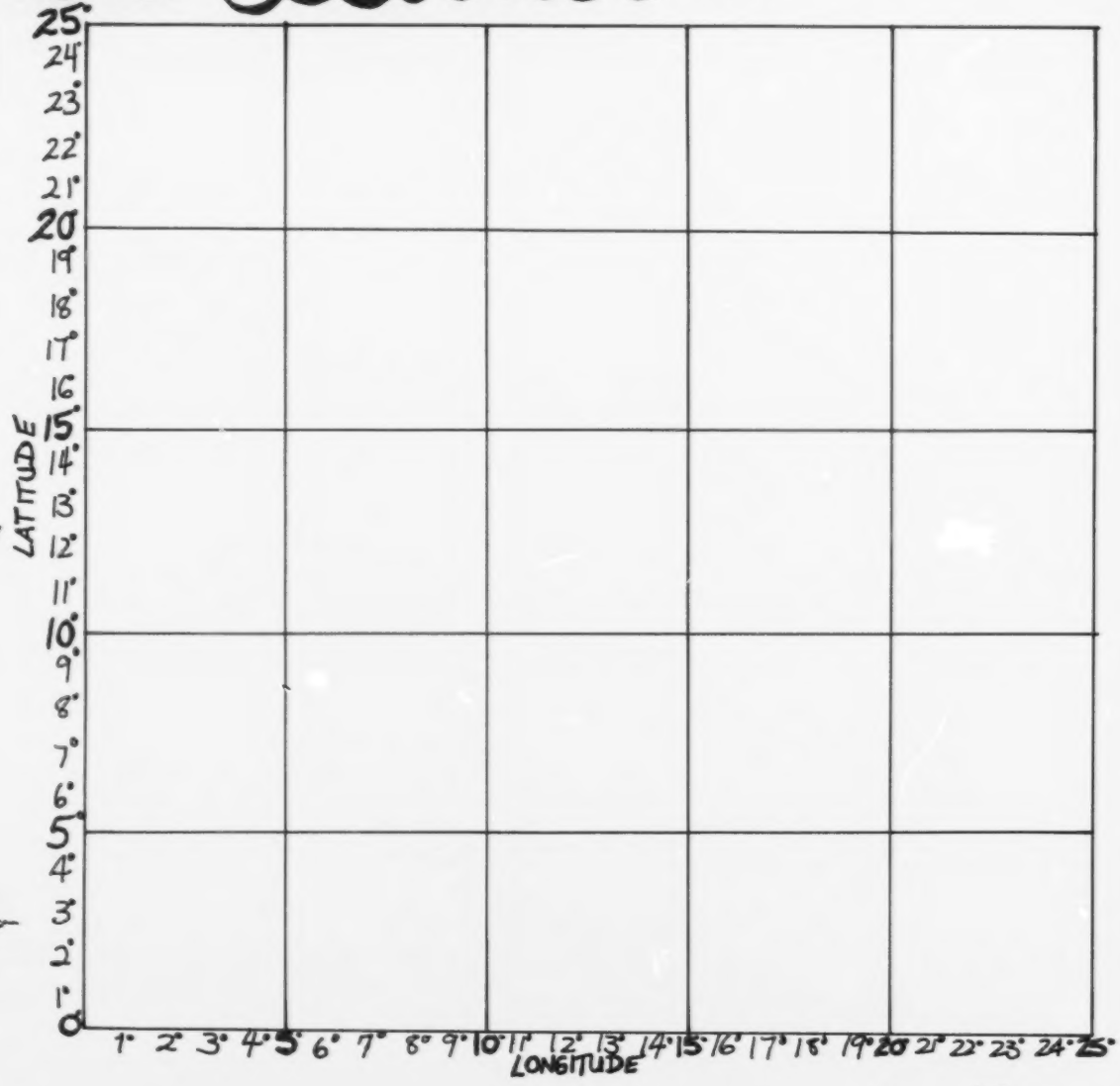
PRACTICE A

Plot each point and connect it to the previous point with a ruler.

Number each point as you plot it.

Note that point 1 and point 13 are the same.

	LATITUDE	LONGITUDE
1.	0°	12°
2.	10°	5°
3.	10°	10°
4.	15°	5°
5.	15°	10°
6.	20°	8°
7.	20°	17°
8.	15°	15°
9.	15°	20°
10.	10°	15°
11.	10°	20°
12.	0°	13°
13.	0°	12°



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PLOT Your Position

CARTOGRAPHER _____

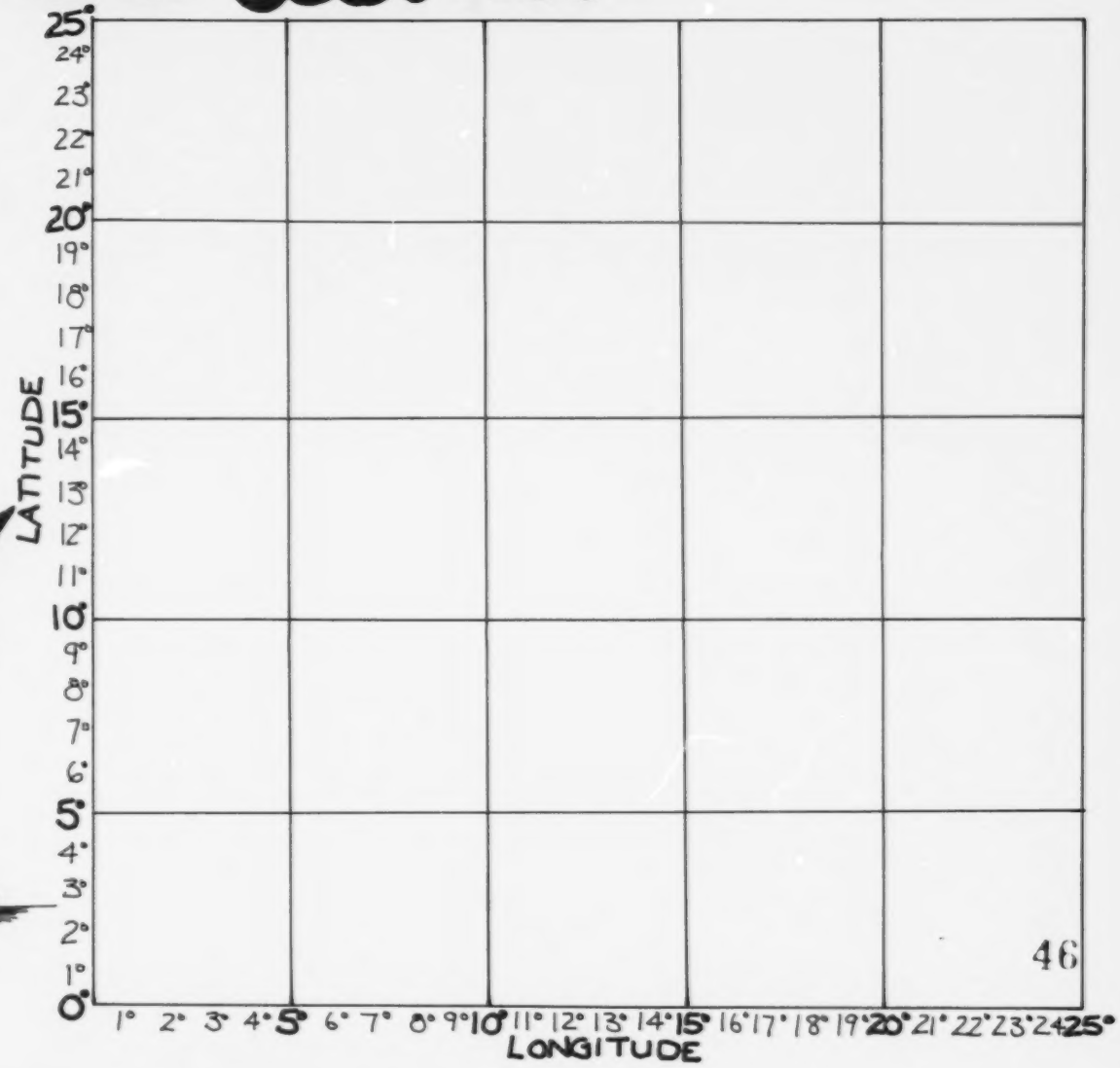
PRACTICE B

Plot each point and connect it to the previous point with a ruler.

Number each point as you plot it.

Note that point 1 and point 13 are the same.

	LATITUDE	LONGITUDE
1.	0°	10°
2.	1°	3°
3.	6°	8°
4.	14°	1°
5.	17°	11°
6.	22°	7°
7.	22°	18°
8.	17°	14°
9.	14°	24°
10.	6°	17°
11.	1°	22°
12.	0°	15°
13.	0°	10°



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PLOT Your Position

Cartographer _____

Mapping Sheet A

A. Look at the points of latitude and longitude listed below. The points, when plotted and connected, will create a fictitious country located somewhere in the world.

B. Write your predictions about this fictitious country:

1. Circle the hemisphere you think that this country is in.

NORTH
WEST EAST
SOUTH

2. Which ocean do you think it would be in? _____

3. What would the nearest continent be? _____

POINTS

	LATITUDE	LONGITUDE
1.	10° N	95° W
2.	0°	90° W
3.	5° S	75° W
4.	10° S	80° W
5.	15° S	75° W
6.	20° S	80° W
7.	25° S	85° W
8.	30° S	90° W
9.	30° S	100° W
10.	20° S	100° W
11.	20° S	110° W
12.	10° S	120° W
13.	5° S	115° W
14.	5° N	115° W
15.	0°	105° W
16.	10° N	95° W

C. Plot your country on the mapping grid. Connect each point to the previous point. Fill in these "facts" about your country. Use a world map.

Country's Name: _____

Hemisphere(s): _____

Ocean(s): _____

Nearest Continent: _____

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PLOT Your Position

Cartographer _____

Mapping Sheet B

A. Look at the points of latitude and longitude listed below. The points, when plotted and connected, will create a fictitious country located somewhere in the world.

B. Write your predictions about this fictitious country:

1. Circle the hemisphere you think that this country is in.

NORTH
WEST ← → EAST
SOUTH

2. Which ocean do you think it would be in? _____

3. What would the nearest continent be? _____

POINTS

	LATITUDE	LONGITUDE
1.	5° N	95° W
2.	4° N	84° W
3.	0°	80° W
4.	4° S	78° W
5.	10° S	82° W
6.	20° S	80° W
7.	22° S	90° W
8.	30° S	98° W
9.	42° S	104° W
10.	38° S	108° W
11.	30° S	106° W
12.	20° S	120° W
13.	14° S	114° W
14.	2° S	114° W
15.	2° N	104° W
16.	5° N	95° W

C. Plot your country on the mapping grid. Connect each point to the previous point. Fill in these "facts" about your country. Use a world map.

Country's Name: _____

Hemisphere(s): _____

Ocean(s): _____

Nearest Continent: _____

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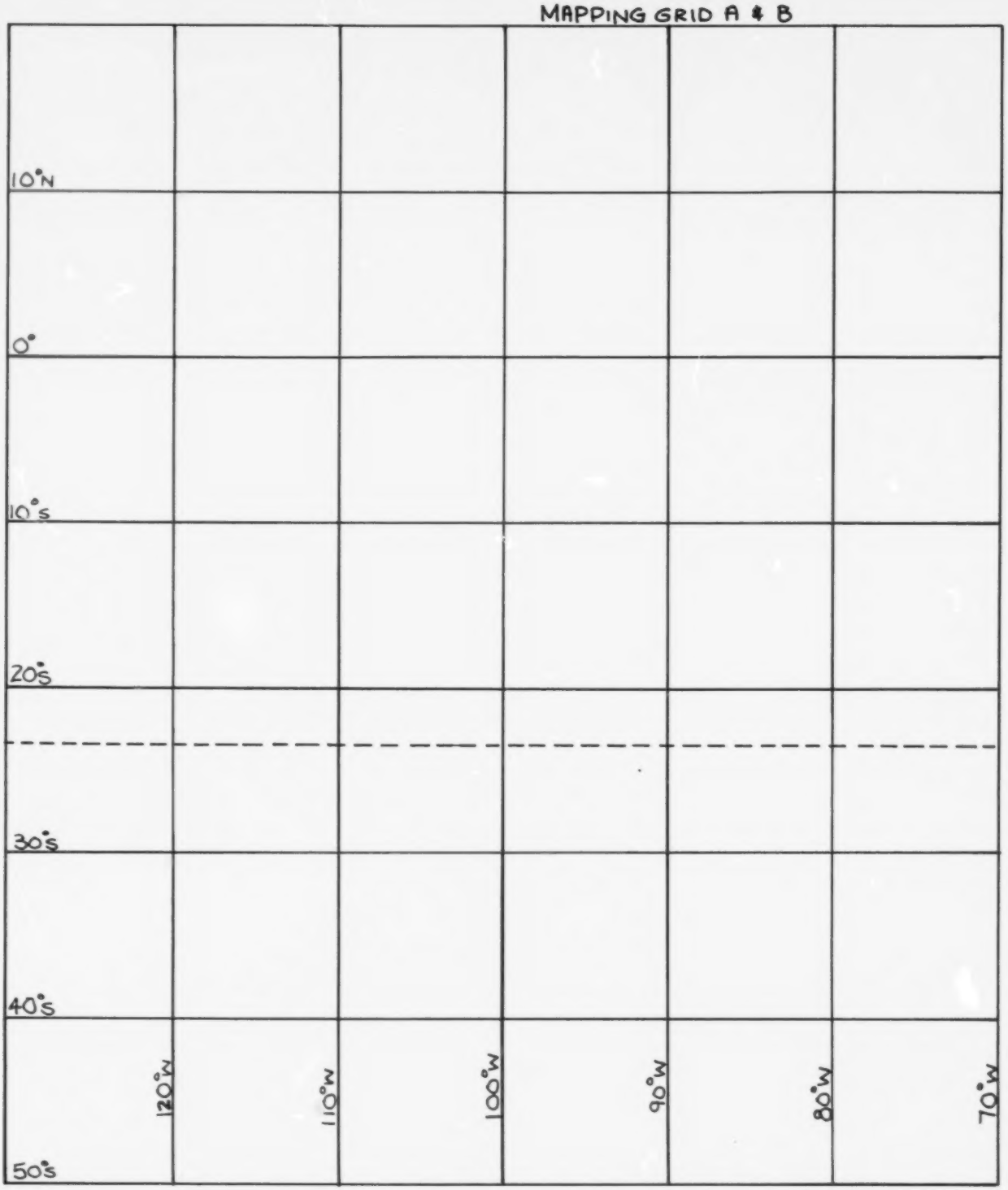
PLOT Your Position

Cartographer

MAPPING GRID A & B



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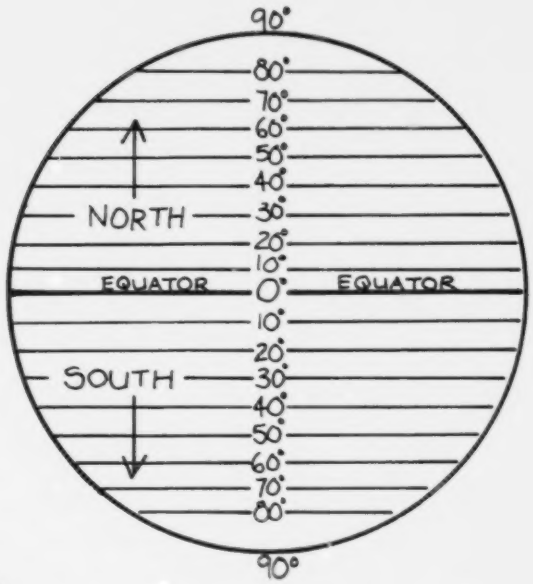
LATITUDE



Latitude is a measurement on a map or globe of locations north and south of the Equator.

Equidistant circles are drawn parallel to the Equator and to each other.

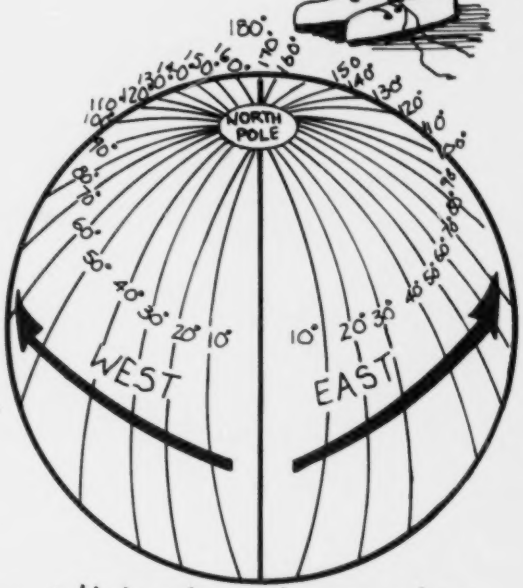
Lines of latitude are also called parallels.

LONGITUDE

Longitude is a measurement on a map or a globe of locations east or west of the Prime Meridian.

The Prime Meridian of Greenwich was chosen as the designated imaginary north-south line that passes through both poles and Greenwich, England.

Longitude is measured 180° East and 180° West of the Prime Meridian.



Lines of longitude are not equidistant and are also called meridians.

The combination of parallels and meridians form a grid for plotting positions anywhere in the world.

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Physically Featured

I. Topic Area
Physical maps

II. Introductory Statement
Given directions, students will draw the approximate physical features of a fictitious country on a map.

III. Social Science Processes
Locating/Organizing data
Interpreting data
Making/Reading maps
Drawing conclusions
Working cooperatively, optional

Science Processes
Interpreting data
Comparing
Generalizing

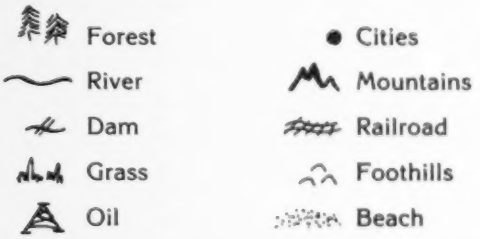
Math Skills
Plotting coordinates
Estimating

IV. Materials
Map worksheets (A easier, B harder) or completed map grids from *Plot Your Position*
Clue sheet, A or B
Colored pencils
Ruler
Follow-up worksheet, language arts coordinate

V. Key Question
How does this country look from an airplane?

VI. Background Information
This investigation may be done following *Plot Your Position* or independently. The fictitious island to be mapped is located in the southern Atlantic Ocean.

Students will be creating their own physical symbols. Examples:



The purpose of this activity is not to create identical or perfect maps. Each child's efforts are likely to be slightly different.

VII. Management
1. Decide which map series to use—A or B.
2. A review of a variety of maps—political, physical, graphic-relief, topographical, special topic, weather—might be useful.
3. Students may need guidance in placing the river and the dam. If the dam coordinates do not coincide with the river, have students place it across the river at a point closest to the given coordinates.
4. The forest area is more easily defined if small pencil marks are first made at each boundary point given in the directions.
5. Allow about 60 minutes for this lesson.
6. Students may work independently or in small groups.
7. The maps in *Economically Speaking* can be used as an answer key.

VIII. Procedure
1. Pass out the appropriate map. Tell students this fictitious country needs physical features.
2. Give students the clue sheet and have them create KEY symbols in the margin for later transfer to the map key.
3. Have students use a lead pencil to draw physical features on the map according to the clues given.
4. After students are satisfied with their results, they may color the map and key using colored pencils. Encourage them to make up names for the country, cities, river, etc.

IX. Discussion
1. Do all the maps look alike? Why or why not? (differences in estimating and symbols chosen) Compare symbols.
2. What does individual interpretation mean? How does it apply to this lesson?
3. What is the difference between approximate and exact?
4. Which features could be placed exactly? (cities)
5. Which features had to be placed approximately? (rivers, mountains, etc.)
6. Is standardization of symbols important? Necessary?
7. What examples of standardization of symbols can you give? (road maps; road signs; symbols used in mathematics; alphabet; etc.)
8. How is a physical map useful? (travel planning—clothes needed for the terrain and climate, deciding the best form of transportation; freeway and highway route planning; etc.)

X. Extensions
1. Invite a surveyor to class to discuss his/her job responsibilities.
2. Reach a consensus on symbols and draw a large scale map mural.
3. Research and discuss ways a real cartographer might draw an accurate map of a country.

XI. Curriculum Coordinates
Language Arts/Art: Design a travel brochure for this fictitious country as described on the worksheet. Bring in sample brochures.

Art: Make a flour/salt relief map or paper mache model of the country.

Science: Discuss the probable climate of this country. Give reasons.

Math: Calculate a scale of kilometers or miles. Figure the distance between certain points in the country.

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Physically Featured

CLUE SHEET A

Next to each clue draw the symbol you will use in your KEY.

1. There are cities located at the following points:

Latitude	Longitude
0°	90°W
10°S	90°W
20°S	100°W
10°S	120°W
30°S	90°W
15°S	110°W

2. There is a low mountain range (up to 1,200m above sea level) located along the west coast from 5°N Lat. 115°W Long. to 20°S Lat. 110W Long.

3. A river originates in the mountains at point 10°S Lat. 115°W Long. It flows eastward across the central part of the country. It passes north of the city at point 10°S Lat. 90°W Long. and continues east, where it flows into the ocean at point 5°S Lat. 75°W Long.

4. A dam has been built across the river as it flows out of the mountains at approximately 10°S Lat. 110°W Long.

5. There is a seaport located at the mouth of the river.

6. A large forested area is located south of the river and east of 95°W Long.

7. Flat grasslands cover most of the north of the river extending to the country's northern boundary.

8. A beach resort area is located south of the forested area and along the southern boundary to point 30°S Lat. 100°W Long.

9. The area bordered by the mountains on the west, the river to the north, and the forest on the east is rolling hills, with scrub bushes and small trees.

10. A railroad runs through the forest from the beach city to the city at the mouth of the river.

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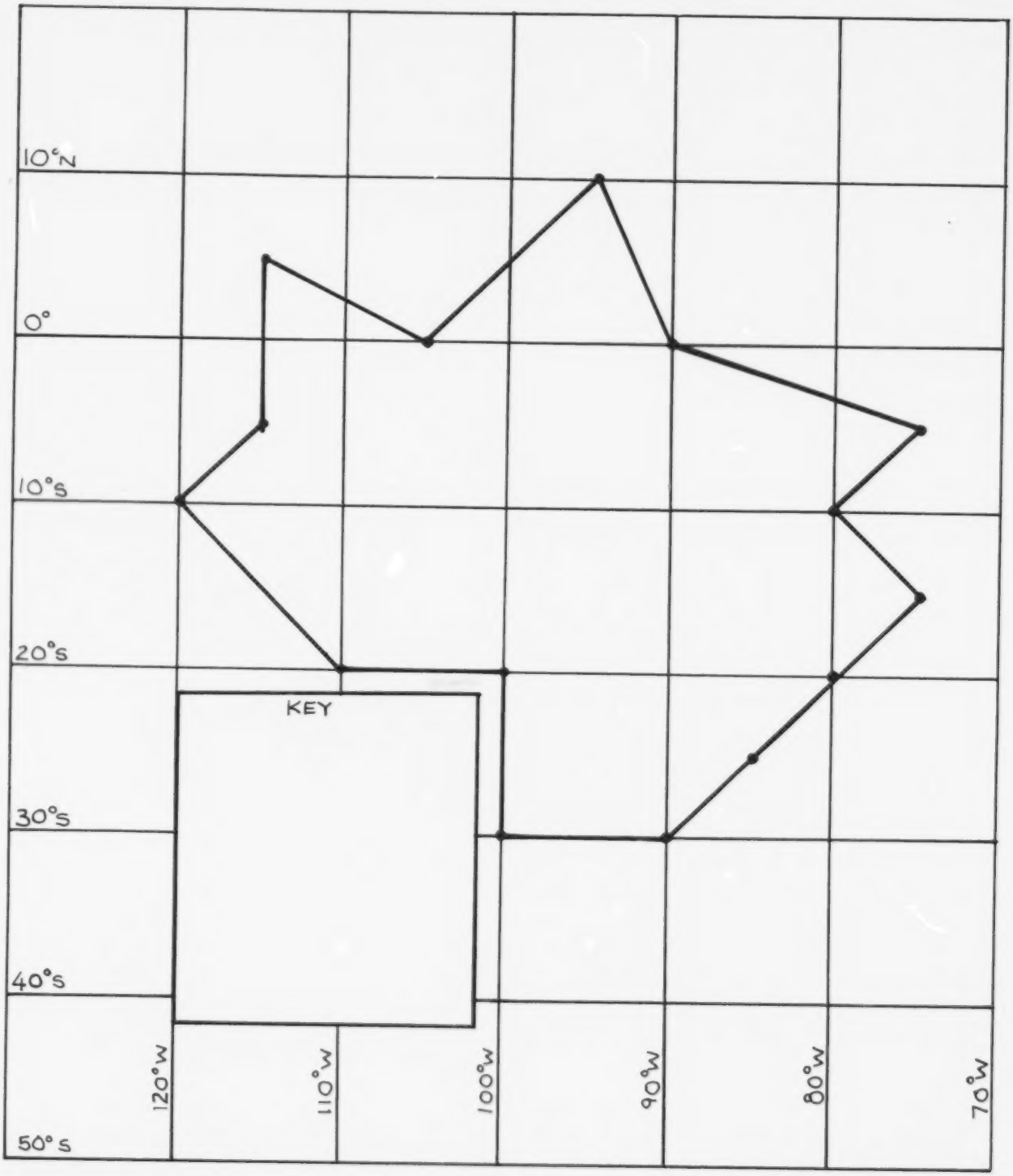
Physically Featured

Cartographer

MAPPING GRID A



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Physically Featured

CLUE SHEET B

Next to each clue draw the symbol you will use in your KEY.

1. There are cities located at the following points:

Latitude	Longitude
5°N	95°W
10°S	82°W
10°S	100°W
2°S	114°W
20°S	110°W
22°S	90°W
30°S	106°W

2. There is a mountain range beginning at point 14°S Lat. 114°W Long. extending South along the west coast to point 40°S Lat. 105°W Long.
---Height up to 3,000m---

3. A river originates in the mountains at 18°S Lat. 114°W Long. It flows in a NE direction, passes along the SE edge of a city, continues to 15°S Lat. 90°W Long, then turns in a SE direction until it empties into the ocean at 10°S Lat. 82°W Long.

4. A dam has been built across the river at 12°S Lat. 106°W Long.

5. An extensive forested area is located south of the river approximately between the following points:

Latitude	Longitude
7°S	90°W
12°S	97°W
15°S	84°W
20°S	91°W
31°S	100°W
20°S	100°W

6. The land north of the river, extending to the northern boundary, is flat grassland with rich soil.

7. Off-shore drilling exists at 38°S Lat. 110°W Long.

8. The triangular area between the river, forest, and mountains is hilly land with scrub bushes and low trees.

9. A beautiful stretch of sandy beach is located between 22°S Lat. 90°W Long. and 20°S Lat. 80°W Long.

10. A railroad connects the city at 30°S Lat. 106°W Long. with the beach resort. It then continues on to the city at the mouth of the river.

11. Two other rail lines leave the city at the mouth of the river. One goes to the city furthest north, the second goes to the city furthest west.

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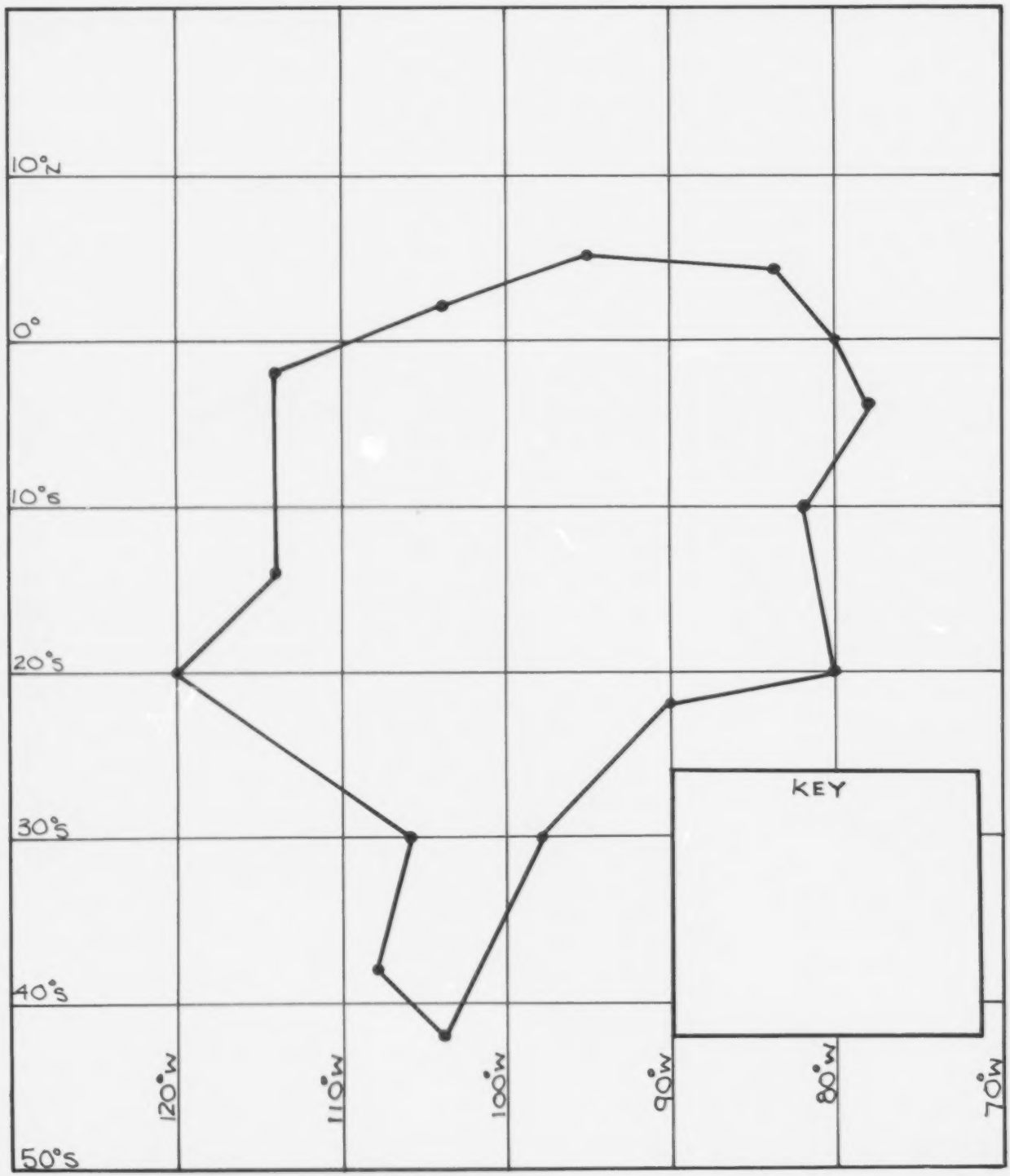
Physically Featured

Cartographer

MAPPING GRID B



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TRAVELING MY WAY ?

PHYSICALLY FEATURED

Design a travel brochure to interest people in visiting your country.

Include:

- pictures with captions
- special features
- recreation such as swimming, hiking, or fishing
- cultural events such as plays or concerts
- historical sites (Here's your chance to make history.)
- transportation (how to get there)

You will want to name the important features.

Country _____

River _____

Dam _____

Forest _____

_____

_____ _____

_____ _____

_____ _____

_____ _____

Railroad _____

Cities

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BEST COPY AVAILABLE

Economically $peaking

I. Topic Area
Economics/Land use

II. Introductory Statement
Students will hypothesize and draw conclusions about the economy of a country based on its physical features.

III. Social Science Processes
Hypothesizing
Classifying
Interpreting data
Drawing conclusions
Working cooperatively
Communicating ideas
Reading maps

Science Processes
Predicting/Inferring
Classifying
Interpreting data

Math Skills
Estimating area/length
Using ratios
Finding percent
Rounding decimals
Graphing, pictograph and circle
Using a protractor
Using a calculator, optional

IV. Materials
Maps created in *Physically Featured* or maps provided (A easier, B harder)
Hypothesis worksheet
Area worksheet and accompanying graph paper
Circle graph worksheet
Calculator, optional
Protractor
Ruler
Colored pencils or crayons

V. Key Question
What physical features give clues to a country's economy?

VI. Background Information
The GNP or Gross National Product as defined by the *Encyclopedia Britannica* "is the total market value of the final goods and services produced by a nation's economy during a specific period of time (usually a year), computed before allowance is made for the depreciation or consumption of capital used in the process of production." NNP or Net National Product would be computed after such an allowance was made.

If this lesson is done independently of *Physically Featured*, students will need to know that they are dealing with a fictitious country. It would be helpful to establish the location of the country in relation to the rest of the world.

After doing the Hypothesis worksheet, the teacher will need to guide discussion and encourage students to give sound reasons for their choices. This could take the form of a debate. A partial list of hypotheses:

Cities—small businesses, tourism, manufacturing
Mountains—mining, paper production, tourism
River/Dam—electric power, farm crops, ranching, paper production, fishing
Forests—paper production, some livestock
Grasslands—farming, livestock
Hilly Land—ranching
Beach—tourism
Railroad—farm crops, ranching, paper production, manufacturing, mining, textiles
Ocean—fishing, tourism, drilling for oil

Estimation is needed when finding the area of each physical feature. If more than half the square is used, it is counted as a whole square. Map A has approximately 250 squares and Map B, 275 squares. Students should count all the way to the edge of the physical feature and/or the country. Expect the total to be less accurate than counting the number of squares in the entire country.

The Circle graph worksheet lists arbitrary percentages that are realistic for the physical makeup of the country. Students should round the number of degrees to the nearest whole.

VII. Management
1. This lesson has three parts:
   a. The Hypothesis sheet and discussion will take about 30 minutes.
   b. The Area worksheet will take 45 minutes or more.
   c. Computing degrees, constructing the circle graph, and discussing the results will take at least 35 minutes.
2. Groups of four promote discussion of ideas, particularly on the Hypothesis sheet. The groups can continue to work together throughout the activity, but each member should be required to complete a circle graph and possibly the pictograph.
3. Symbols on the pictograph must be evenly spaced.

VIII. Procedure
Students will:
1. Use *Physically Featured* maps or those provided to make a list, on scratch paper, of anything they feel this country might produce based on these features.

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2. Do the Hypothesis worksheet as a group. Discuss choices as a class.
3. Count graph paper squares, as directed on the Area sheet, to find the area covered by each physical feature. Hold paper up to a window or light if necessary. Each graph paper square equals one kilometer. (Hint—25 graph paper squares equal 1 square on the latitude/longitude grid)
4. Complete the area table and illustrate the data on a pictograph.
5. Discuss ways to find the lengths requested at the bottom of the worksheet; i.e., using the edge of the graph paper.
6. Compute the number of degrees representing each economic factor for Map A or Map B and illustrate with a circle graph.
7. Hold a concluding discussion under the teacher's guidance.

IX. Discussion

1. Do the physical features of a country affect its economy? How?
2. Which physical features provide for the various economic factors presented in the worksheet? (See Background Information.)
3. What type of products do you think this country might export?
4. What products might this country need to import?
5. Would this country attract a lot of tourists? Why or why not? Is it near major shipping or air lanes?

X. Extensions

1. Use the list of major economic factors to determine specifics regarding this country's economy. For example, manufacturing might include cheese production from dairy farms, textiles from cotton, meat processing plants from ranching, paper mills from lumber. etc.
2. Contact a travel agent to establish existing cruise lines and airlines that currently operate in the area of the fictitious country. Draw a map showing where flights and cruises might originate.
3. Compare the economy of this fictitious country to another in the same part of the world.
4. Research the division of the U.S. economy and illustrate with a circle graph.

XI. Curriculum Coordinates

Language Arts: Write an article describing the types of jobs available for someone who might want to move to this country.

Science: Research the types of marine life to be found in this area of the world. Add drawings of these to the map.

Art: Make a scale model of this country using material from nature.

Music: Make up a National Anthem.

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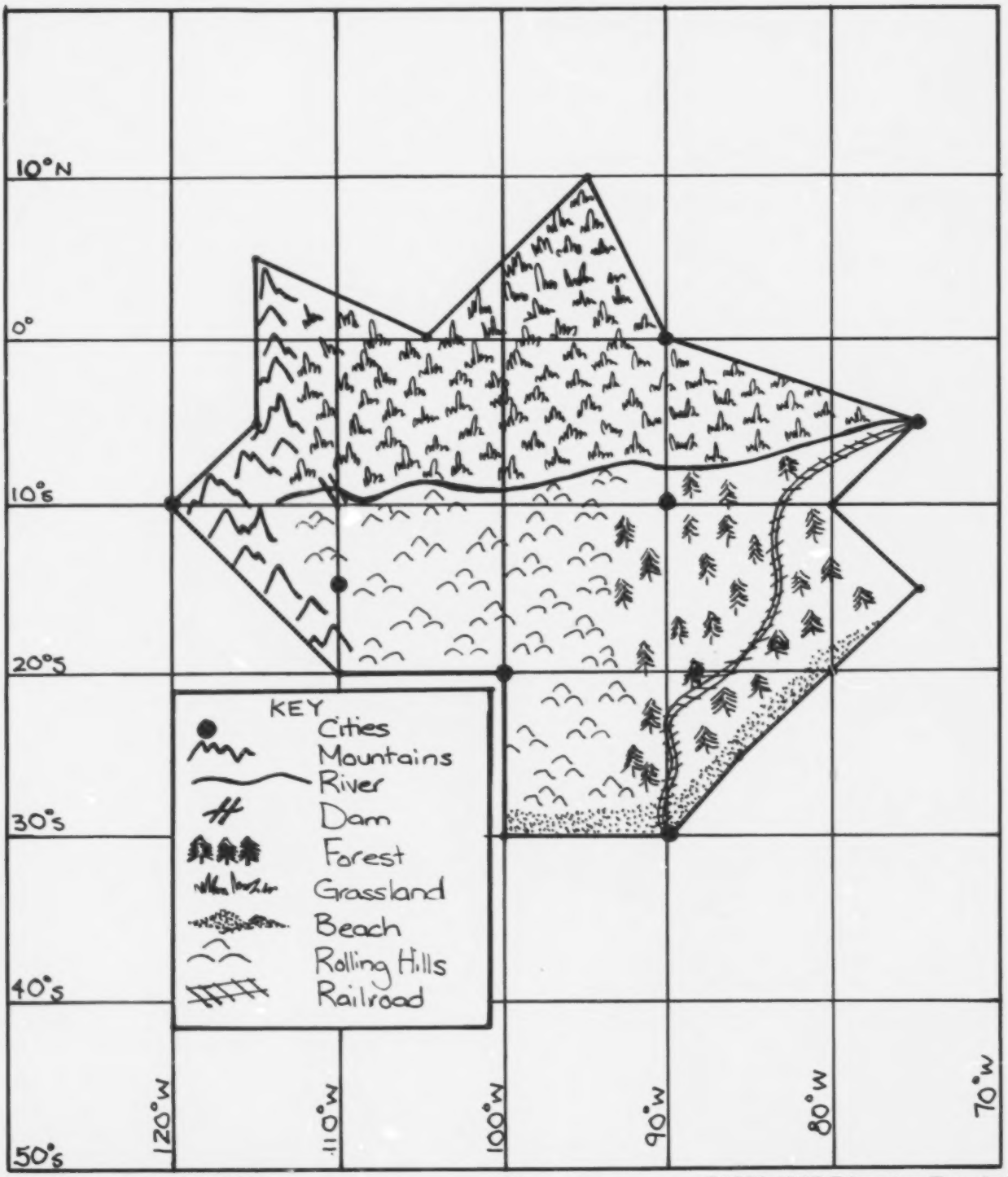
Economically $peaking

MAPPING GRID A



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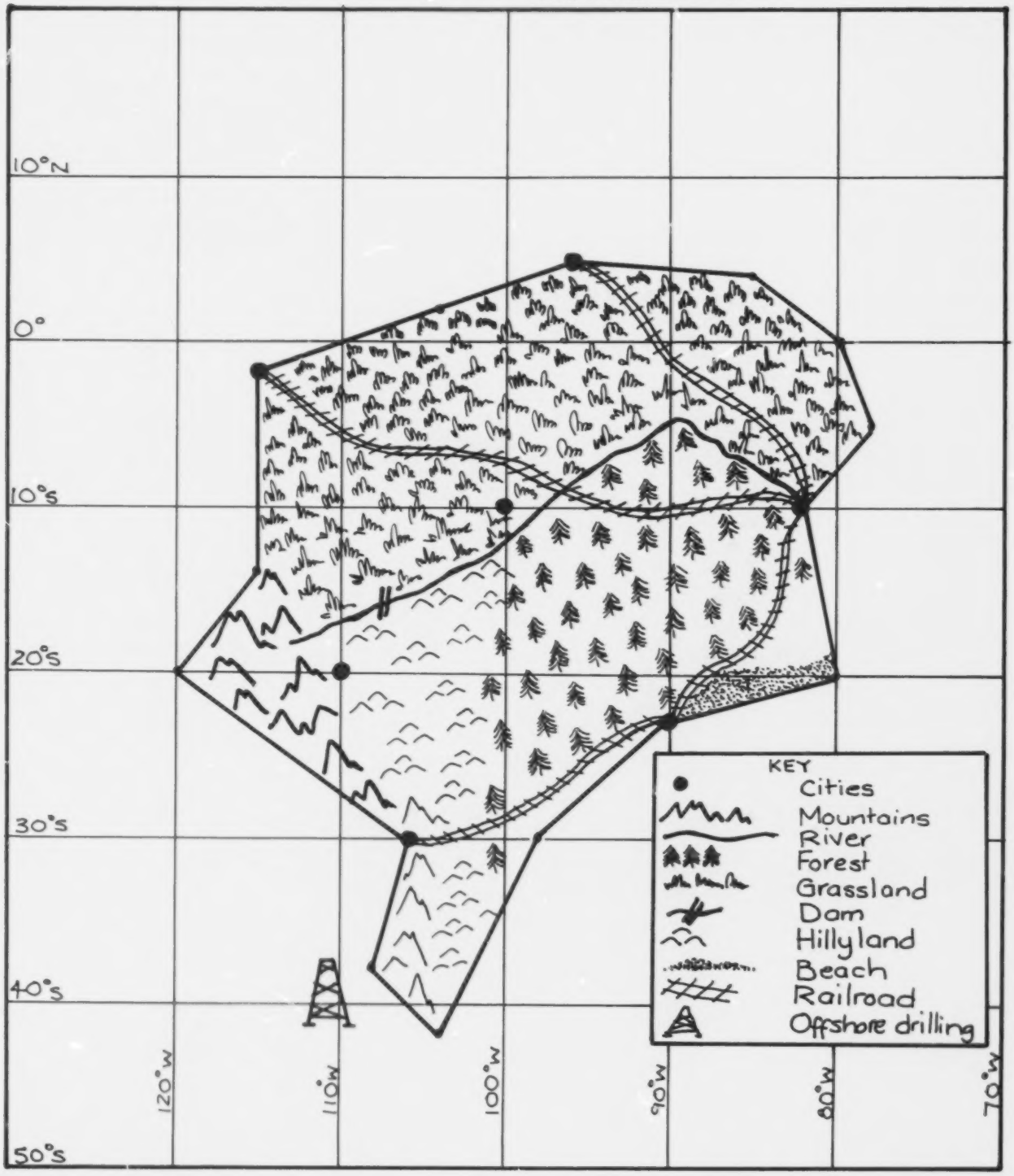
MAPPING GRID B



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A & B

Economic Prognosticators _____

HYPOTHESIZE!

Place a "Y" for YES in each box where you think the physical feature would support the economic factor. Be ready to offer reasons for your choices.

PHYSICAL FEATURES	ELECTRIC POWER	DAIRY FARMING	FARM CROPS	RANCHING	PAPER PRODUCTION	FISHING	SMALL BUSINESSES	TOURISM	MANUFACTURING	MINING	DRILLING FOR OIL	TEXTILES
	ECONOMIC FACTORS.											
CITIES												
MOUNTAINS												
RIVER												
FOREST												
GRASSLANDS												
HILLY LAND												
BEACH												
RAILROAD												
OCEAN												
DAM												

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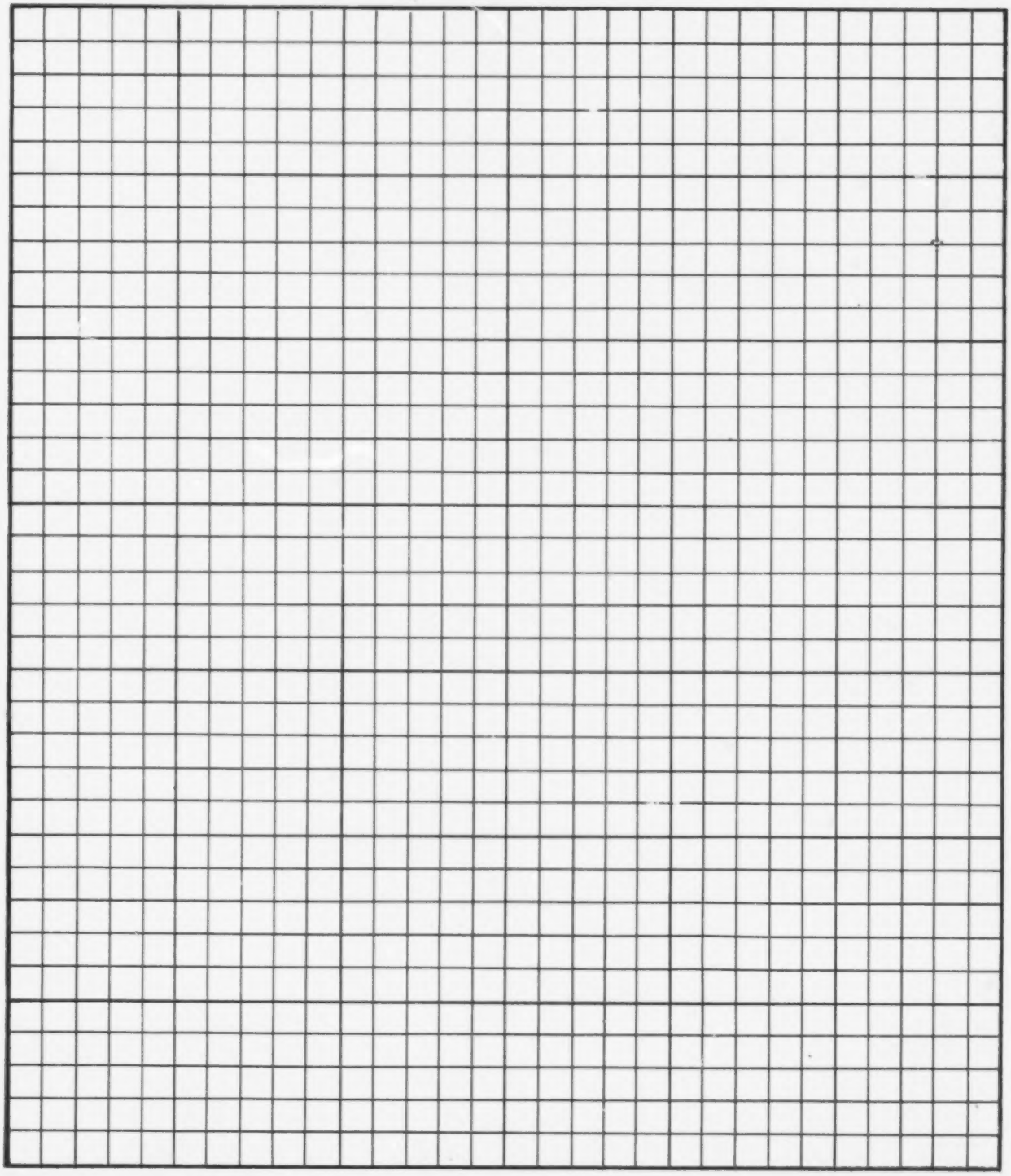
Economically $peaking

One square = One square kilometer



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Economically $peaking

A+B

_____
_____
_____
_____
Economists

AREA

1. Place the graph paper behind your map. Count the approximate number of square kilometers of each feature. Total these numbers to find the approximate area (km^2) of the entire country. Complete the chart below.

	KM^2	$\frac{KM^2}{TOTAL\ KM^2}$	PERCENT
MOUNTAINS			
GRASSLANDS			
FORESTS			
HILLY LAND			
BEACH			
TOTAL			

2. Use the information above to create a pictograph!

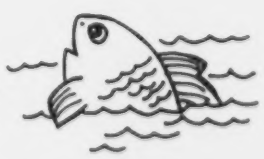
MOUNTAINS															
GRASSLANDS															
FORESTS															
HILLY LAND															
BEACH															

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

KM^2

3. How many kilometers?

River _____
Railroad _____
Country at widest point _____
Country at longest point _____
Shore to drilling site (B only) _____



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Economically $peaking

CIRCLE GRAPH

Economist _____

Complete the table. Round degrees.

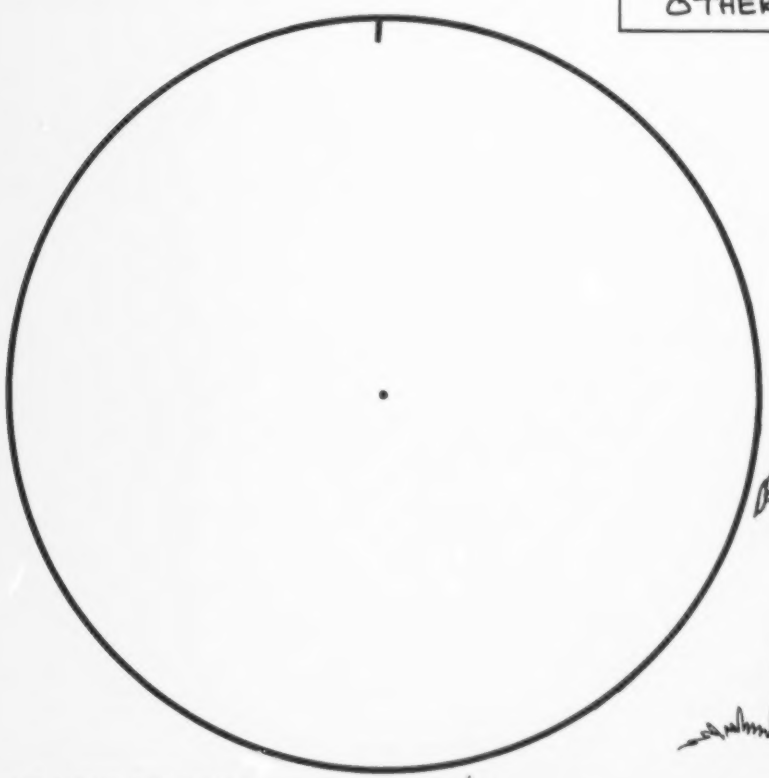
$$\frac{(\% \div 100)}{\text{Percent in decimal form}} \times \frac{360}{\text{Degrees in circle}} = \frac{\quad}{\#\text{ of degrees}}$$

MAP A ONLY

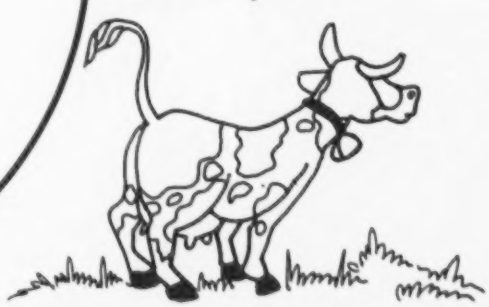
ECONOMIC FACTOR	% OF GNP	# OF DEGREES
LIVESTOCK	10%	
AGRICULTURE	20%	
MINING	10%	
TIMBER RELATED INDUSTRY	25%	
FISHING RELATED INDUSTRY	15%	
MANUFACTURING	15%	
TOURISM	1%	
OTHER	4%	

MAP B ONLY

ECONOMIC FACTOR	% OF GNP	# OF DEGREES
LIVESTOCK	6%	
AGRICULTURE	23%	
MINING	5%	
TIMBER RELATED INDUSTRY	15%	
FISHING RELATED INDUSTRY	25%	
MANUFACTURING	7%	
PETROLEUM	14%	
TOURISM	2%	
OTHER	3%	



Use the above information to draw a circle graph depicting the GNP for MAP A or MAP B. Color and label each part.



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I'VE GOT THE WORLD ON A STRING

I. Topic Area
Distances on a globe

II. Introductory Statement
Students will use a string and calculations to determine distances between two points on a globe.

III. Social Science Processes
Locating/Organizing data
Working cooperatively
Communicating ideas
Drawing conclusions
Reading maps

Science Processes
Measuring/Comparing
Collecting/Recording data
Inferring

Math Skills
Estimating
Measuring
Using ratio and proportion
Using a calculator
Rounding

IV. Materials
String with no elasticity, about 1 meter per group
Meter tapes, 1 per group
Worksheets
5 or more globes (sizes need not be the same)
Kilometer post materials (see Background Information)

V. Key Question
How can we find distances on a globe?

VI. Background Information
PROPORTION

Each map or globe is drawn to a scale. Because this scale is consistent throughout a particular map or globe, it can be matched with the actual measurements of the Earth.

How is the formula for converting string length to kilometers determined? First find the globe's circumference by measuring the Equator in centimeters (nearest tenth). Then find the centimeter distance between two cities on the globe. Set this up as a ratio:

$$\frac{\text{Measured distance between 2 points on a globe}}{\text{Circumference of globe}} \rightarrow \frac{16.2 \text{ cm}}{118 \text{ cm}}$$

Then relate this ratio to a similar ratio of the actual kilometers. The Earth's circumference at the Equator is 40,075 km (24,900 miles). The unknown is the actual distance between the two cities. When the two ratios are used together, it is called a proportion. With three pieces of information, it can be solved for x. For example:

Set up proportion. $\frac{16.2 \text{ cm}}{118 \text{ cm}} = \frac{x}{40{,}075 \text{ km}}$

Cross multiply. $118x = 16.2 \times 40{,}075$

$118x = 649{,}215$

Isolate x by dividing.

$x = 649{,}215 \div 118$

$x = 5{,}502$ km

MEASUREMENT

Stretch a string between two cities on any size globe. Mark the string with pen, pencil, or knots and measure the centimeter distance (to the nearest tenth) with a meter tape. Use the proportion to find the kilometers between two cities.

THE KILOMETER POST

1. Materials
   a. Outside: Use a tetherball pole and attach cardboard, plywood, or plastic markers.
   b. Inside: Insert a cylindrical object (broomstick, pipe, or mailing tubes connected together, etc.) into a Christmas tree stand. Attach arrow signs.
2. Gathering Information
   a. Measure from a common starting point (Example: your city).
   b. Decide the cities to be included on the kilometer post. Consider those currently in the news or part of the curriculum.
   c. Find the distance between the starting point and the chosen city by the same process used in the rest of the activity.
   d. Determine the direction of the chosen city from the starting point. Possible labels should include N, S, E, W, NW, SW, NE, and SE.
   e. Make directional signs (North/South, East/West) and mount on top of the post. Attach city signs to the kilometer post facing in the proper direction.

VII. Management
1. Have students do the ESTIMATED KM column, one at a time. The first one may be a completely blind guess. After finding the actual kilometers, have them make the next estimation. Experience should improve accuracy. Ac-

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curacy in measurement should also be stressed.

2. The length of time needed for this activity will depend on student ability levels. It can be divided into three parts. The initial activity will take about 60 minutes. A second period can be used for the open-ended questions on the next worksheet. A third period will be needed to construct the kilometer post.
3. Groups of four or five are recommended, depending on how many globes are available. Job descriptions such as City Locator, String Stretcher, Mathematician, Estimator, and Recorder could be used so that all members of the team have a specific job.
4. When building a class kilometer post, each group should contribute at least two arrow signs showing city and distance. Direction may be penciled in on the back so proper placement can be made.
5. Representatives from each group should build the post while individual groups are making their arrow signs.

VIII. Procedure

DAY ONE

Each student group will:

1. Measure around the Equator of their globe in centimeters.
2. Estimate the number of kilometers from New York to San Francisco.
3. Study the proportion with the teacher's guidance.
4. Use string to measure the distance between the two cities.
5. Complete the proportion and find the actual kilometers.
6. Continue to complete the rest of the table.
7. Discuss the results.

DAY TWO

8. Explore and record answers to the questions on the second page.
9. Share their findings.

DAY THREE

10. Construct the kilometer post and decide the cities to be listed on it.
11. Be responsible for gathering data, designing, and placing two or more signs on the post.

IX. Discussion

1. Why is using a non-rigid measuring device beneficial when determining distances on a globe? (It can be placed along a curve.)
2. Why are the distances measured by a string not accurate for determining driving miles? (Bodies of water and landforms such as mountains cause land routes to be altered.) Relate to question 1 on the kilometer post worksheet.
3. a. Why is a polar route preferable when flying to some Asian or European countries? (shorter distances, less air traffic than when flying over populated areas)
   b. Why do people in Alaska have air travel benefits that people in the continental U.S. do not have? (Since they are closer to the North Pole, the polar route allows them to travel a shorter distance to places in the Northern Hemisphere.)
4. When planning a trip, why is knowing how to determine approximate distances necessary? (expenses can be approximated and the time necessary to complete the journey allotted)
5. Why is this form of measuring distances accurate whatever the size of the globe used? (Every globe is drawn to scale. This consistency makes it possible to compare the actual size of the Earth to any globe.)

X. Extensions

1. Invite a pilot to discuss how air routes are determined.
2. Brainstorm factors important when planning a long distance trip. Then invite a travel agent to speak about trip planning.
3. Plan a trip around the world. Determine stopover points and calculate the total distance to be traveled.

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I'VE GOT THE WORLD ON A STRING

Names _____

1. Measure the Equator of your globe. The circumference is _____ cm.

2. Use this proportion to find the distance between any two points on your globe:

$$\frac{\text{Distance between 2 pts. on globe (cm)}}{\text{Circumference of globe (cm)}} = \frac{\text{(Actual distance between 2 pts.)} \times}{40{,}075 \text{ km (Actual circumference of the Earth)}}$$

CITIES	ESTIMATED KM	PROPORTION	ACTUAL KM
New York / San Francisco		_____ = _____ / 40,075	
Seattle / Miami		_____ = _____	
Anchorage / Tokyo		_____ = _____	
Cairo / Perth		_____ = _____	
Bogata / Capetown		_____ = _____	
		_____ = _____	
		_____ = _____	

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Names _____

I'VE GOT THE WORLD ON A STRING

1. Measure the Equator of your globe. The circumference is _____ cm.

2. Use this proportion to find the distance between any two points on your globe:

$$\frac{\text{Distance between 2 pts. on globe (cm)}}{\text{Circumference of globe (cm)}} = \frac{\text{(Actual distance between 2 pts.)} \times}{\text{40,075 km (Actual circumference of the Earth)}}$$

3. Find pairs of cities separated by about 2,000 km. Name each city and country. How many cm is 2,000 km on your globe? _____ cm

_____ and _____

_____ and _____

4. Find pairs of cities 10,000 km apart. What is the measure of 10,000 km on your globe? _____

_____ and _____

_____ and _____

5. Find pairs of cities _____ km apart. They would measure _____ on my globe.

_____ and _____

_____ and _____

6. Find two cities separated by the same distance as Lima, Peru and San Francisco, United States. What is the measured distance on your globe? _____. What is the actual kilometer distance? _____

_____ and _____

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I'VE GOT THE WORLD ON A STRING

Names _____

1. As the crow flies, the distance from Washington D.C. to San Francisco is about 3,930 kilometers (2,440 miles). The driving distance is about 4,720km(2,930miles). What factors would cause the difference?

_____

_____

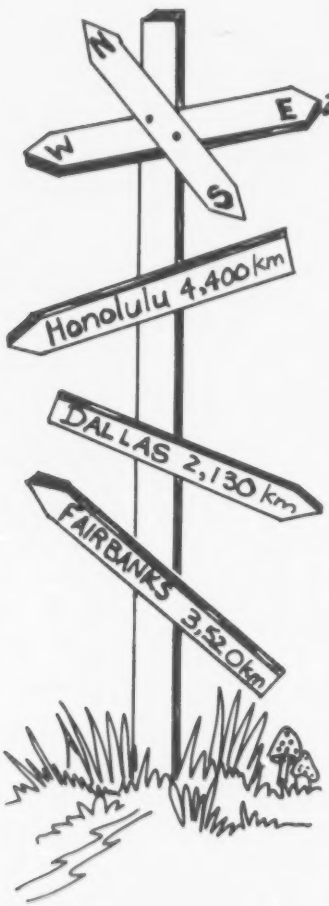
_____

2. Why do people in Alaska have air travel benefits that people in the continental U.S. do not have?

_____

_____

CONSTRUCT A KILOMETER POST



1. Common starting point: _____

2.

CITIES	KM	DIRECTION FROM STARTING POINT

3. Place East-West/North-South arrows at the top of the post. Attach city signs facing the proper direction.

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South American Jigsaw

I. Topic Area
Countries of South America

II. Introductory Statement
Students will place the South American countries in the proper geographical positions through clues requiring inductive reasoning.

III. Social Science Processes
Making maps
Working cooperatively
Communicating ideas
Organizing data

Science Processes
Comparing
Interpreting data

Math Skills
Solving problems
Using logic

IV. Materials
Worksheets
Scissors
Glue

V. Key Question
How do the countries of South America fit together?

VI. Background Information
This activity might be used as an introduction to the study of South American geography or history. The map should look like the one shown.

Inductive reasoning involves moving from the specific to the general. In its truest sense, a generalization is formed based on a few specific examples. This often happens in the scientific process. This activity uses a more general form of inductive reasoning. It starts with clues about the positions of individual countries in relation to each other and results in a visual generalization of the political boundaries of South America.

VII. Management
1. Prior experience with logic and inductive reasoning is helpful.
2. It is essential that students know the position of the three bodies of water (Caribbean Sea, Atlantic Ocean, and Pacific Ocean) which surround South America.
3. The class may be divided in one of two ways.
   a. Students can work independently with their own maps and clues.
   b. Groups of four can share one set of clues and a map. The clues can also be cut into four sections, each member reading their own clues aloud as many times as requested but not allowing others to see them.
4. This activity will take 30 minutes or more.

VIII. Procedure
Students will:
1. Cut out the 13 countries of South America.
2. Label the Pacific Ocean, Atlantic Ocean, Caribbean Sea, and compass rose on the outline map.
3. Use the countries, the outline map of South America, and the clues to correctly assemble the continent. No resource maps allowed!
4. Glue the assembled countries onto the outline map after checking the clues to make sure they match the map.
5. Discuss the activity with the teacher's guidance.

IX. Discussion
1. What clues were most helpful in getting started?
2. Describe how you solved the problem. In what order did you work?
3. What country did you find the hardest to locate? Why?
4. Did you find anything frustrating? Explain.

X. Extensions
1. Using physical and political maps, draw and label the major cities, rivers, and mountains of South America. Draw the Equator.
2. Do *A Patch of North America*.

XI. Curriculum Coordinates
Language Arts/Logic/Geography: Make a set of clues for arranging the provinces of Canada or placing the physical landmarks (mountains, valleys, national parks, lakes, etc.) in a state.

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South American Jigsaw

Use the clues below to correctly place the countries on the South American map. Optional: Cut the clues along the dotted lines and give one to each group member. At the group's request, clues can be read aloud any number of times but may not be passed to other members.

---

1. Brazil borders all the countries except Ecuador and Chile.

2. The countries bordering the Pacific Ocean are Chile, Peru, Colombia, and Ecuador.

3. Bolivia and Paraguay are the only countries not bordering an ocean.

---

4. Argentina and Chile are the farthest south of all the countries.

5. Argentina is bordered by Chile, Bolivia, Paraguay, Brazil, Uruguay and the Atlantic Ocean.

6. Suriname is located between French Guiana and Guyana.

---

7. The countries bordering the Atlantic Ocean are Uruguay, Guyana, Argentina, Suriname, Brazil, and French Guiana.

8. Colombia touches Central America.

9. Venezuela and Colombia border each other and the Caribbean Sea.

---

10. Ecuador is between Colombia and Peru.

11. Bolivia is farther northwest than Paraguay.

12. Guyana is on the eastern border of Venezuela and north of Brazil.

REVIEW THE CLUES TO MAKE SURE THEY AGREE WITH YOUR COMPLETED MAP.

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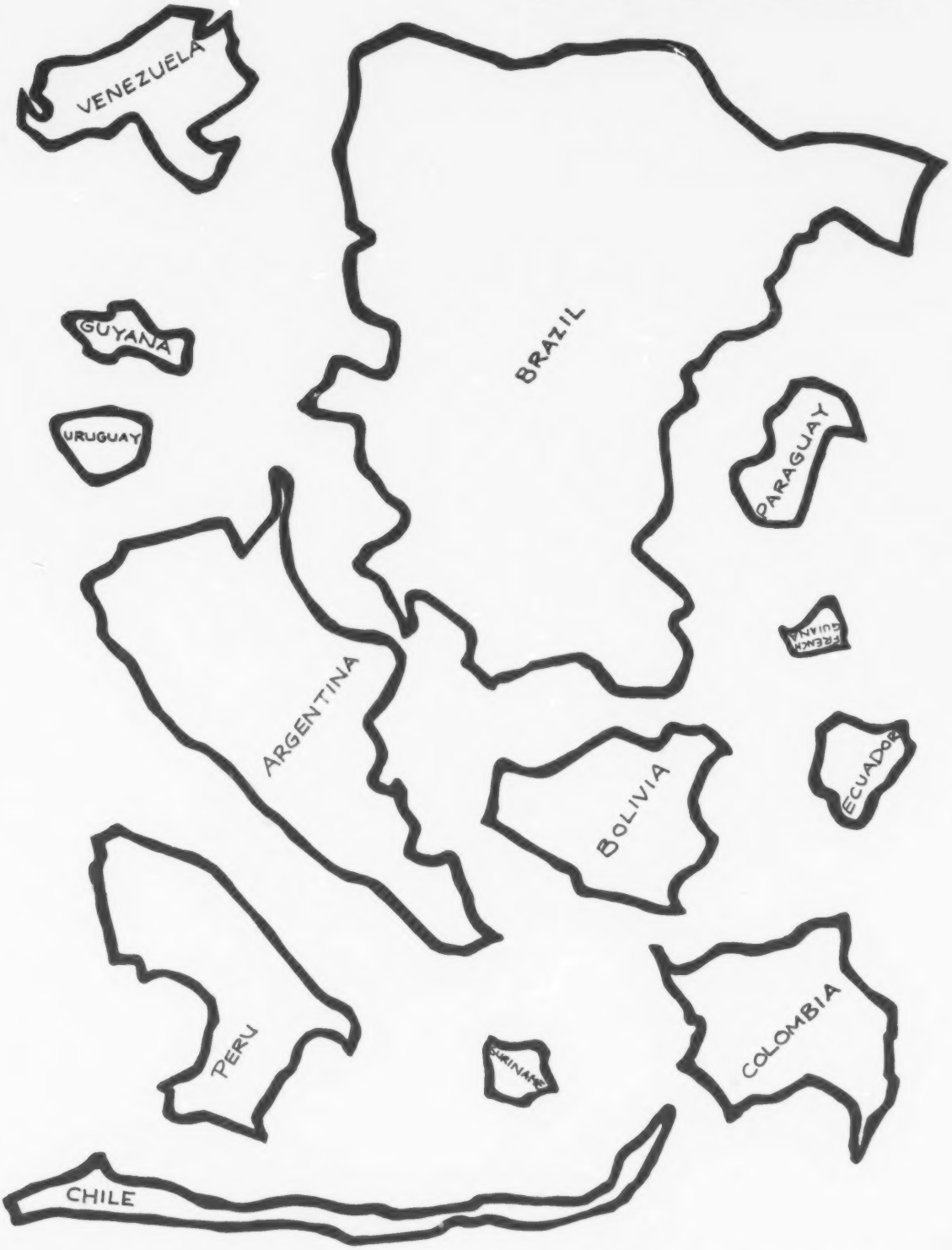
South American Jigsaw

Cut out these countries.



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South American Jigsaw

Label the Pacific Ocean, Atlantic Ocean, Caribbean Sea, and the compass rose.

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A patch of North America

I. Topic Area
Lower countries of North America

II. Introductory Statement
Students will place the North American countries in the proper geographical positions through clues requiring inductive reasoning.

III. Social Science Processes
Making maps
Working cooperatively
Communicating ideas
Organizing data

Science Processes
Comparing
Interpreting data

Math Skills
Solving problems
Using logic

IV. Materials
Worksheets
Scissors
Glue

V. Key Question
Where in the world is Belize (bə-lēz′)?

VI. Background Information
Current events demand that we understand the geography of North and Central America. This activity could be used as an introduction. The completed map should look like the one shown.

Inductive reasoning involves moving from the specific to the general. In its truest sense, a generalization is formed based on a few specific examples. This often happens in the scientific process. This activity uses a more general form of inductive reasoning. It starts with clues about the positions of individual countries in relation to each other and results in a visual generalization of the political boundaries of North America.

VIII. Procedure
Students will:

1. Cut out the countries of North America and glue the map together.
2. Label the Pacific Ocean, Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and the compass rose on the outline map.
3. Use the countries, the outline map of North America, and the clues to correctly assemble the continent. No resource maps allowed!
4. Glue the assembled countries onto the outline map after checking the clues to make sure they match the map.
5. Discuss the activity with the teacher's guidance.

IX. Discussion
1. What country was hardest for you to locate? Why?
2. Is it important to know where these countries are located? Why? (Fast transportation and instant communication have made the world seem much smaller and closer to us. Literate people need to know about their neighbors; important world events take place in these countries.)

X. Extensions
1. Using physical and political maps, draw and label the major cities, rivers, and mountains of North America.
2. Do *South American Jigsaw*.

XI. Curriculum Coordinates
Language Arts/Logic/Geography: Write a set of clues for arranging another part of the world, placing the physical landmarks in a state, locating rooms within a building, finding places of interest in a city, etc. For example, if the class is reading "From the Mixed-Up Files of Mrs. Basil E. Frankweiler" by E. L. Konigsburg, the layout of one floor of the Metropolitan Museum of Art in New York City might be an interesting challenge.

VII. Management
1. Prior experience with logic and inductive reasoning is helpful.
2. Students must know the position of the Pacific Ocean, Atlantic Ocean, Caribbean Sea, and Gulf of Mexico to use the clues.
3. The class may be divided in one of two ways.
   a. Students can work independently with their own maps and clues.
   b. Groups of four can share one set of clues and a map. Cut the clues into four sections and give one to each member. Clues can be read aloud as many times as requested, but other group members are not allowed to see them.
4. This activity will take a minimum of 30 minutes.

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A Patch of North America

Use the clues below to correctly place the countries on the partial map of North America. Optional: Cut the clues along the dotted lines and give one to each group member. At the group's request, clues can be read aloud any number of times but may not be passed to other members.

---

1. Panama touches Colombia.
2. Guatemala is on the southern border of Mexico.
3. Nicaragua borders Honduras.

---

4. Puerto Rico is the easternmost island shown in the Caribbean Sea.
5. Belize and El Salvador both border Guatemala.
6. Costa Rica is one country away from South America.

---

7. Cuba is directly south of a peninsula in the United States.
8. Almost all of the beaches in Honduras are along the Caribbean Sea.
9. Haiti and the Dominican Republic share an island. Of the two, Haiti is closer to Mexico.

---

10. The Pacific Ocean touches the western coast of El Salvador.
11. Jamaica is directly north of Panama.
12. Mexico is between the Pacific Ocean and the Gulf of Mexico.

REVIEW THE CLUES TO MAKE SURE THEY AGREE WITH YOUR COMPLETED MAP.

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A patch of North America

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A patch of North America

Cut along dotted line and glue, matching along solid line.

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Label the Pacific Ocean, Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and the compass rose.

Getting There

I. Topic Area
Compass directions

II. Introductory Statement
Students will use compass directions to find points on the playground and best transportation routes on a map.

III. Social Science Processes
Making/Reading maps
Formulating questions
Working cooperatively
Communicating ideas

Science Processes
Comparing
Recording data

Math Skills
Estimating direction
Reading a compass
Computing scale ratio

IV. Materials
Worksheets
Construction or ditto paper for playground map
Fact sheet, "The Compass".
Magnetic compasses, 1 per group suggested
1 paper fastener per group, optional
Calculators, optional

V. Key Question
How can you avoid getting lost?

VI. Background Information
See the fact sheet, "The Compass".

The scale format used by The National Geographic Society has been chosen for this book. Where a metric or standard length is used for actual and scale dimensions, a ratio is written first. Then a number comparison is written to the unit of measurement.

Example: 1:50 or 5 centimeters to the millimeter

When a non-standard measurement such as walking steps is converted to metrics, the ratio is omitted.

Example: 5 steps to the centimeter

VII. Management
1. The length of time necessary to complete this activity will vary with the abilities of the students.
   a. Allow about 25 minutes to discuss the fact sheet and check understanding, and another 25 minutes for Part A, using a compass rose.
   b. Part B will take approximately 40 minutes for map reading, creating questions, and question sharing. It combines directions with surface routes.
   c. Part C, the playground map, may take two class periods, one to gather data and one to draw the map. Have groups head to different landmarks or stagger the starting time to keep students from clustering around each landmark.
2. Partners are recommended for all of these activities.
3. Find the declination (see fact sheet) for your location. Sources include a declination chart, a USGS map, or your shadow. When the sun is directly overhead, your shadow will point to true north. Finding out how much the compass deviates from this shadow is another way to determine declination.
4. For Part A, students can place the compass rose at the top of the sheet or attach it with a paper fastener. This simulates a real map. For students who may have difficulty, the compass rose can be attached to the starting point.
5. Part C calls for the use of a compass to direct students through their playground maps. However, once students find north, a compass may not be necessary for those who are comfortable with their directions.
6. Options for measuring distances between landmarks for Part C include a trundle wheel, a piece of string marked in meters, or someone who can pace it off with uniform steps.
7. Data will vary because groups will take different courses to measure landmarks. However, the maps should be similar.

VIII. Procedure
The teacher will:
1. Present the fact sheet and check for understanding.
2. Introduce Part A by having students cut out the compass rose and placing it with north facing in whatever direction the teacher chooses.

Students will:
3. Record "North points _____". For example, "North points between B and C" or "North points to K". Students need to be able to determine directions whatever the orientation of the compass rose. Up is not always north.
4. Write the cardinal and intermediate initials for points A through L.
5. Repeat the above process after rotating the compass to a new position as directed by the teacher.
6. Use the Part B fictional map to answer Part B questions. Then they will create questions of their own.

The teacher will:
7. Direct a discussion of strategies for completing Part C.
   a. Use a book or clipboard for writing.

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b. Identify and agree upon appropriate landmarks that everyone will place on their maps.

Students will:

8. Determine north with a compass, adjusted for declination (see fact sheet).
9. Go outside. Measure distances and determine compass directions for the identified landmarks.
10. Determine the scale to be used and figure the scale distance.
11. Draw a playground map from the data collected. Label the landmarks.
12. Brainstorm different ways in which compass directions are used by people in their jobs, hobbies, etc.

IX. Discussion

1. Why must you know where north is before you can give compass directions? (All compass directions are based on the position of north.)
2. In what way are compass directions much more accurate than giving directions by saying, "Go left at the tree" or similar directions? (They give a common point of reference.)
3. Give reasons why an airline pilot or ship captain must know compass directions. (lack of landmarks)
4. Why do we always travel in many directions on land before we reach a destination that is in a straight line from us? (Surface routes must be altered because of landforms or water.)
5. In how many ways can compass directions be used? (to give someone specific directions around town, for taking the correct freeway exits or entrances [North Hwy 1, South Hwy 1], to guide airline pilots and ship navigators, to help cross country hikers find their way, to read a map, to guide explorers over land with no landmarks such as Antarctica, to survey land, etc.)

X. Extensions

1. Bring in a pilot to discuss how directions are found in an airplane.
2. Using road maps, have students give directions from one location to another including compass directions and route.
3. Take a walking tour of the neighborhood or town, following oral or written compass directions. For example, have students give directions from one place of business to another.

XI. Curriculum Coordinates

Language Arts:

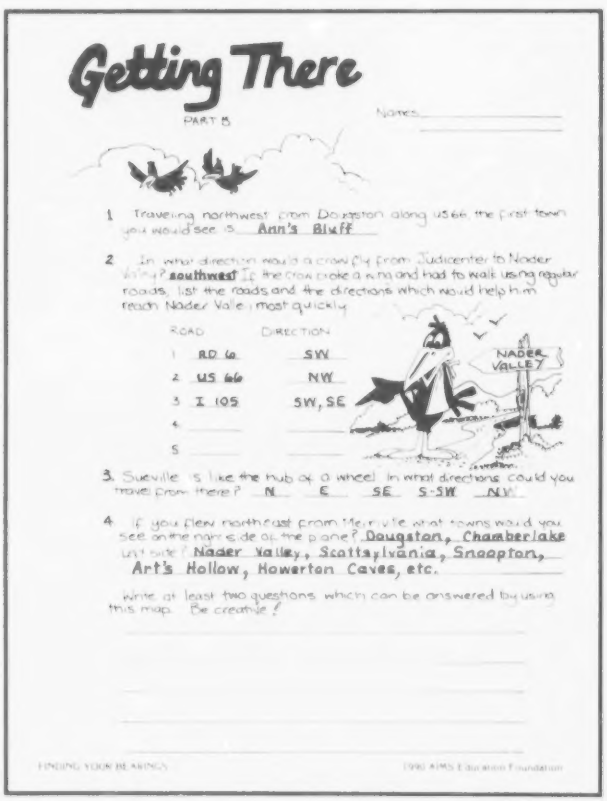
1. Write a report on cartographers or orienteering.
2. Research how the stars were used to guide ships.
3. Write a creative story on the problems Columbus or some other explorer might have had without a compass or the stars.

Art:

Create a fictional map. Write questions which require its use.

Computer:

Use the interactive program, "Cross-country USA", by Didatech Software. It integrates the planning of road routes using compass directions, U.S. geography, problem solving, and economics. Suggested for 4th grade and up.



Getting There

PART B

Names _____

1. Traveling northwest from Dougston along US 66, the first town you would see is Ann's Bluff

2. In what direction would a crow fly from Judicenter to Nader Valley? southwest If the crow broke a wing and had to walk using regular roads, list the roads and the directions which would help him reach Nader Valley most quickly.

	ROAD	DIRECTION
1	RD 6	SW
2	US 66	NW
3	I 105	SW, SE
4		
5		

NADER VALLEY

3. Sueville is like the hub of a wheel. In what directions could you travel from there? N E SE S-SW NW

4. If you flew northeast from Merryville, what towns would you see on the right side of the plane? Dougston, Chamberlake Last side? Nader Valley, Scottsylvania, Snoopton, Art's Hollow, Howerton Caves, etc.

Write at least two questions which can be answered by using this map. Be creative!

FINDING YOUR BEARINGS ©1990 AIMS Education Foundation

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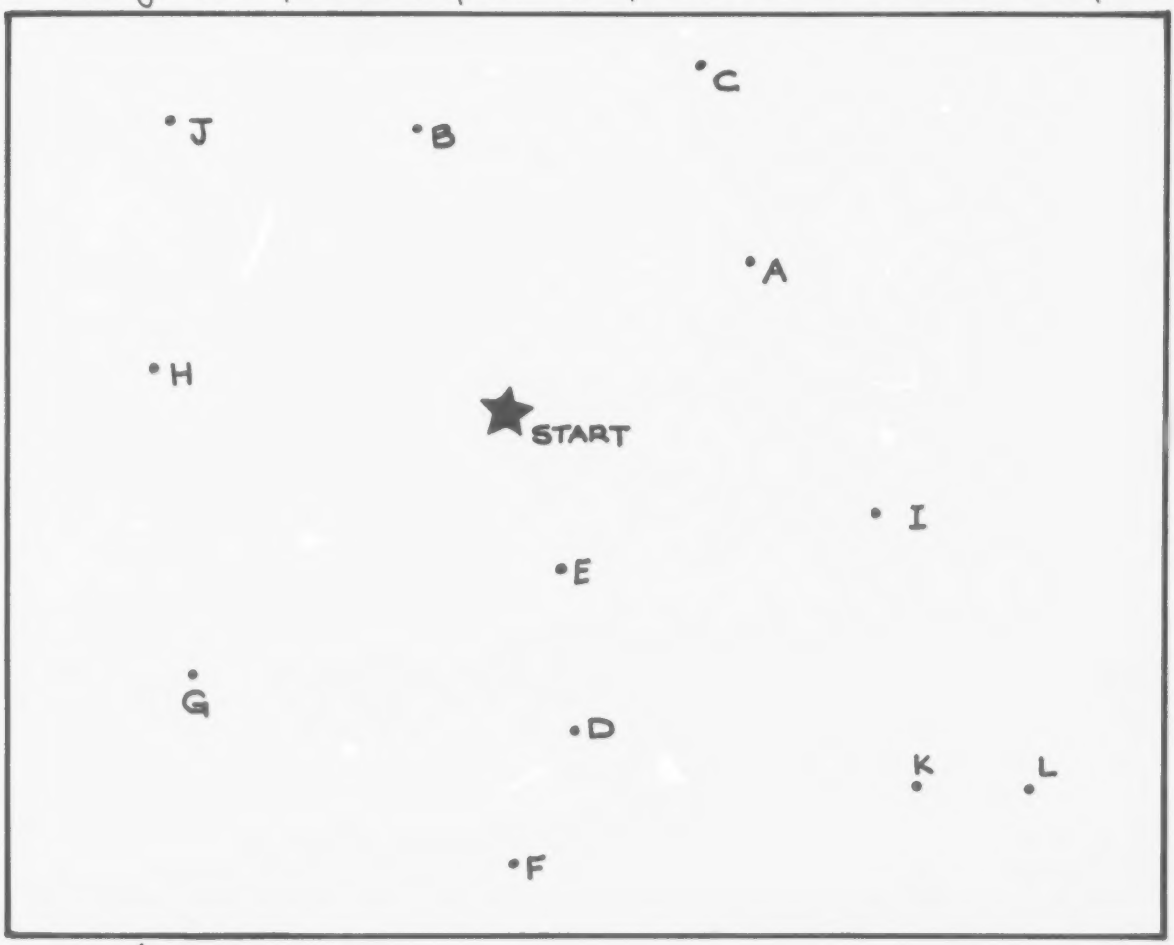
Getting There

Names _____

_____

PART A

1. Cut and place the compass rose on the map as directed. Record the cardinal (N, S, E, W) and intermediate (NE, NW, SE, SW) directions from **START** to each letter.
2. Change the position of the compass rose as directed and repeat.



North points _____

A _____	G _____
B _____	H _____
C _____	I _____
D _____	J _____
E _____	K _____
F _____	L _____

North points _____

A _____	G _____
B _____	H _____
C _____	I _____
D _____	J _____
E _____	K _____
F _____	L _____

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Getting There

PART B

Names_____

_____

1 Traveling northwest from Dougston along US 66, the first town you would see is_____.

2. In what direction would a crow fly from Judicenter to Nader Valley?_____ If the crow broke a wing and had to walk using regular roads, list the roads and the directions which would help him reach Nader Valley most quickly.

	ROAD	DIRECTION
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

3. Sueville is like the hub of a wheel. In what directions could you travel from there? _____ _____ _____ _____ _____

4. If you flew northeast from Merriville, what towns would you see on the right side of the plane?_____

Left side?_____

_____

Write at least two questions which can be answered by using this map. Be creative!

_____

_____

_____

_____

_____

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Getting There

Names _____

PART C - PLAYGROUND MAP

1. Determine north with a compass.
2. Start at a corner of your playground. Measure (trundle wheel, string, or walking steps) and record the distance to each landmark. Also record the direction.
3. Decide on a scale. Example: 5 steps to the cm
4. Draw a map using the information you collected. Label the landmarks.

EXAMPLE:

SE PLAYGROUND CORNER	TETHERBALL	NW	14 STEPS	2.8 CM

SCALE _____ to the _____ cm

FROM	TO	DIRECTION	DISTANCE	SCALE DIST.

Think! In how many ways can compass directions be used ?

_____

_____

_____

_____

_____

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THE COMPASS

A compass is a device for determining directions. There are three kinds. The magnetic compass is directed by the Earth's magnetism and points to magnetic north. In its simplest form, it is a magnetic needle which turns on a pivot. A gyrocompass is directed by the Earth's rotation. It is not affected by magnetism and points to true north. A solar or astrocompass depends on the visible sun or stars. It works in reverse of a sundial.

Several countries claim to have invented the magnetic compass. The earliest evidence shows the Chinese used one in 1100, the Western Europeans in 1187, the Arabs in 1220, and the Scandinavians in 1250.

Early ships were wooden so simple magnetic compasses were satisfactory. They usually consisted of a magnetic bar floating in water. Today large ships use a Mariner's compass, a large magnetic compass. A Mariner's compass has several magnets fastened on a flat disk called a compass card. The entire assembly rests on a pivot and is contained in a glass bowl filled with a non-freezable liquid. Since a magnetic compass is affected by the metal used in a ship's construction, adjustments must be made. It is usually used together with a gyrocompass which points to true north.

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True or geographical north is what we call the North Pole. Magnetic compasses point to magnetic north which is located near the northern islands of Canada. Magnetic north is determined by the magnetic fields of the Earth and moves a few miles from year to year.

The difference between magnetic north and true north at your particular location is called declination and is measured in degrees. It varies from place to place on the Earth. To use a magnetic compass accurately, find and set the degree of declination to the right or left of North. In the central Sierra Nevada mountains of California, a magnetic compass should be set to point between 16 and 17 degrees to the right of north. On the East Coast, it will be set a certain number of degrees to the left. United States Geological Survey maps, often used by backpackers, are one source of degrees of declination for your locality.

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NORTH
NORTH-NORTHEAST
NORTHEAST
EAST- NORTHEAST

EAST
EAST-SOUTHEAST
SOUTHEAST
SOUTH-SOUTHEAST

SOUTH
SOUTH-SOUTHWEST
SOUTHWEST
WEST-SOUTHWEST

WEST
WEST-NORTHWEST
NORTHWEST
NORTH-NORTHWEST

Boxing the compass refers to naming the 32 points marked on the compass face. Modern magnetic compasses are marked with the 16 main points shown above as well as the 360 degrees of a circle. North is at 0°, East at 90°, South at 180°, and West at 270°. North, south, east and west are called cardinal points. Intercardinal or intermediate points are northeast, northwest, southeast, and southwest.

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Fire on the Mountain

I. Topic Area
Fire lookout simulation

II. Introductory Statement
Students will use compasses to locate points on a map and solve problems typical of those a forest service lookout may have.

III. Social Science Processes
Reading maps
Working cooperatively
Drawing conclusions
Interpreting data
Communicating ideas
Solving problems

Science Processes
Identifying variables
Measuring/Comparing
Interpreting data

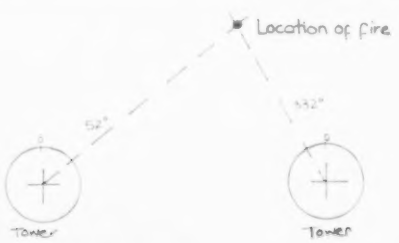
Math Skills
Estimating distances
Measuring
Reading a compass
Using logic
Problem solving

IV. Materials
Worksheets and Map
Metric rulers, one per student

V. Key Question
How can a compass locate fires, assist campers, and save lives?

VI. Background Information
The ability to determine direction and distance are two key skills that a forest service lookout must have to protect the lives of many people and sometimes thousands of acres of land. Towers are often equipped with direction finders, telephones, short wave radios, and binoculars. The lookout, after seeing suspicious smoke, will contact another forest service tower to see if they can confirm the smoke and help pinpoint the exact location. Airplanes and people living in the area may also be contacted to confirm a possible fire.

How is the location of the fire determined? Two lookout towers each measure the direction of the fire with compass degrees. A line extending from that angle on a map will intersect with one from the other tower, pinpointing the location of the suspected fire. Then the appropriate support personnel can be notified.



On the map provided, the lookout stations are 56 kilometers apart. The tower is in the middle of the compass and north is the same on each compass. Aside from distance and direction, variables such as firefighter location, mountain elevations, and non-threatening smoke will call upon the problem solving and logical thinking skills of the persons working on this simulation.

VII. Management
1. Cooperative groups of two or three are suggested. Possible job titles are Lookout (reads scenario), Fireboss (locates smoke position on map), and Commander (keeps crew on task, records answers, and directs discussion).
2. The amount of time needed will vary with the grade level.
   a. Setting up groups, studying background information, reviewing compass skills, and completing the Training Sheet will take about 50 minutes.
   b. Completing and discussing the Daily Log will take at least another 50 minute period.
3. Students will be using the circle protractor feature on the compasses; preliminary experience in reading protractor degrees is recommended.
4. Always measure degrees and distances from the center intersection of the compasses. These are the tower locations.
5. When locating a fire, encourage students to place two straight edges in position to find the intersection. Light lines can also be drawn but may become confusing as more are added. Put an X on the intersection.

VIII. Procedure
The teacher will:
1. Put the class into groups of two or three.
2. Present the problem of detecting forest fires from a lookout station. Use the Background Information or have students research their own.
3. Distribute the map and have students study it. Point out the distance scale and mountain elevations.

The students will:
4. Practice using the map and the compass by completing the Fire Lookout Training Sheet.
5. Study the Scenario carefully.
6. Solve the problems posed by the Daily Log.

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The teacher will:

7. Bring the groups together and guide a class discussion of findings and questions.

IX. Discussion

1. What is the most difficult part of a fire lookout's job? (being alone for long periods of time)
2. Why is teamwork necessary to be a good lookout? (so you can locate a fire by triangulation)
3. Is the human element necessary to be a lookout, or could lookouts be replaced by machines? (Humans are necessary because visual observation, interpretation of smoke, and decision making are not within the realm of artificial intelligence given to machines.)
4. Discuss where each group would locate the new Crystal Point Lookout. Evaluate their reasons. (Consider surrounding elevations, distance from other lookout, etc.)

X. Extensions

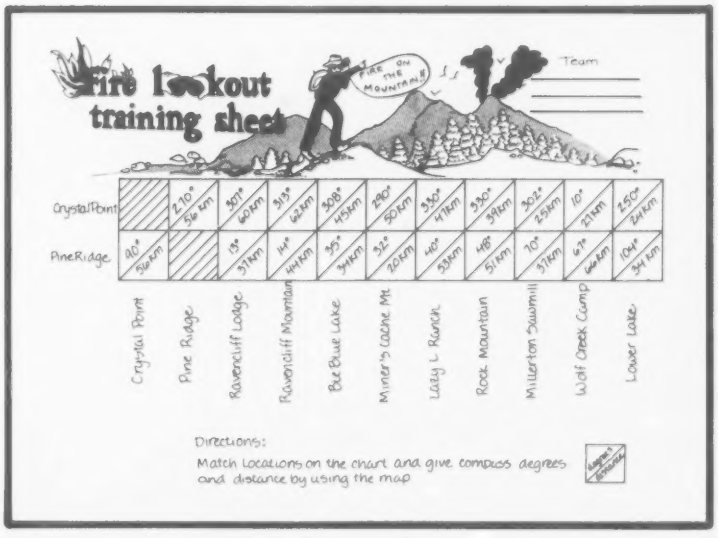
1. Invite a forest service lookout to describe their job.
2. If your school is located near a national forest, visit a lookout station on a field trip.

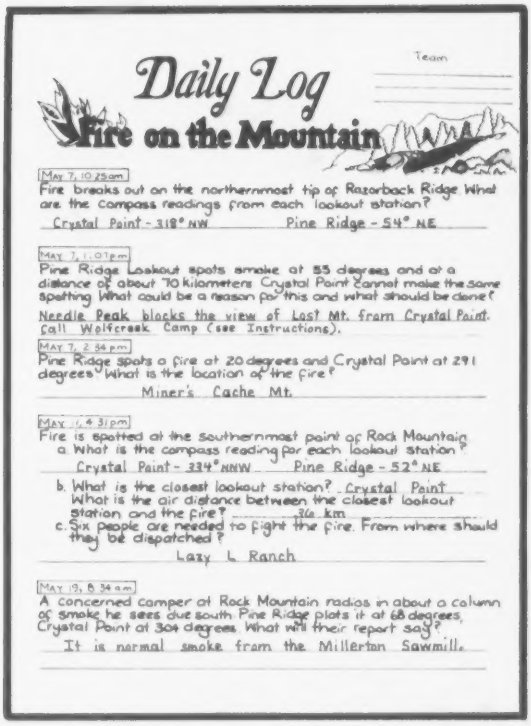
XI. Curriculum Coordinates

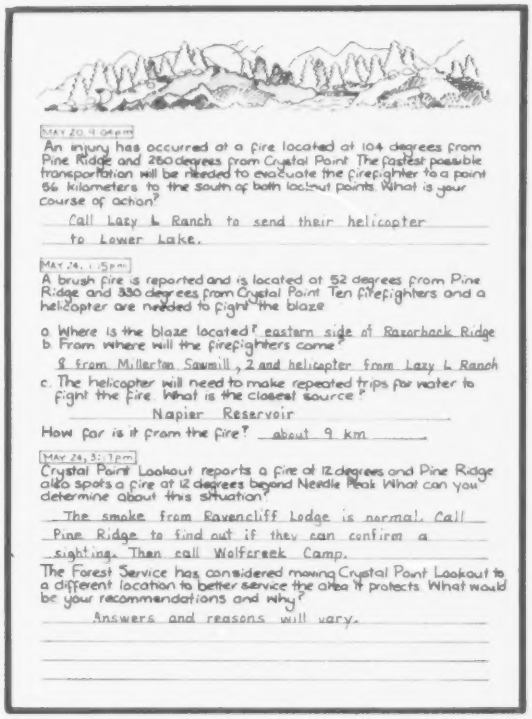
Language Arts:

1. Research the history of fire lookout stations.
2. Use the map to continue writing the daily log through the month of June.
3. Use actual forest service maps to set up a new scenario.

Art/Language Arts: Design a different forest service map and write scenarios for classmates to solve.




Daily Log
Fire on the Mountain
Team
May 7, 10:25am
Fire breaks out on the northernmost tip of Razorback Ridge. What are the compass readings from each lookout station?
Crystal Point - 318° NW
Pine Ridge - 54° NE
May 7, 1:07pm
Pine Ridge Lookout spots smoke at 55 degrees and at a distance of about 70 kilometers. Crystal Point cannot make the same spotting. What could be a reason for this and what should be done?
Needle Peak blocks the view of Lost Mt. from Crystal Point. Call Wolfcreek Camp (see Instructions).
May 7, 2:56 pm
Pine Ridge spots a fire at 20 degrees and Crystal Point at 291 degrees. What is the location of the fire?
Miner's Cache Mt.
May 14, 4:31pm
Fire is spotted at the southernmost point of Rock Mountain.
a. What is the compass reading for each lookout station?
Crystal Point - 334° NNW
Pine Ridge - 52° NE
b. What is the closest lookout station? Crystal Point
What is the air distance between the closest lookout station and the fire? 36 km
c. Six people are needed to fight the fire. From where should they be dispatched?
Lazy L Ranch
May 19, 8:34 am
A concerned camper at Rock Mountain radios in about a column of smoke he sees due south. Pine Ridge plots it at 68 degrees, Crystal Point at 304 degrees. What will their report say?
It is normal smoke from the Millerton Sawmill.


May 20, 9:04am
An injury has occurred at a fire located at 104 degrees from Pine Ridge and 250 degrees from Crystal Point. The fastest possible transportation will be needed to evacuate the firefighter to a point 56 kilometers to the south of both lookout points. What is your course of action?
Call Lazy L Ranch to send their helicopter to Lower Lake.
May 24, 1:15pm
A brush fire is reported and is located at 52 degrees from Pine Ridge and 330 degrees from Crystal Point. Ten firefighters and a helicopter are needed to fight the blaze.
a. Where is the blaze located? eastern side of Razorback Ridge
b. From where will the firefighters come?
8 from Millerton Sawmill, 2 and helicopter from Lazy L Ranch
c. The helicopter will need to make repeated trips for water to fight the fire. What is the closest source?
Napier Reservoir
How far is it from the fire? about 9 km
May 24, 3:17pm
Crystal Point Lookout reports a fire at 12 degrees and Pine Ridge also spots a fire at 12 degrees beyond Needle Peak. What can you determine about this situation?
The smoke from Ravencliff Lodge is normal. Call Pine Ridge to find out if they can confirm a sighting. Then call Wolfcreek Camp.
The Forest Service has considered moving Crystal Point Lookout to a different location to better service the area it protects. What would be your recommendations and why?
Answers and reasons will vary.

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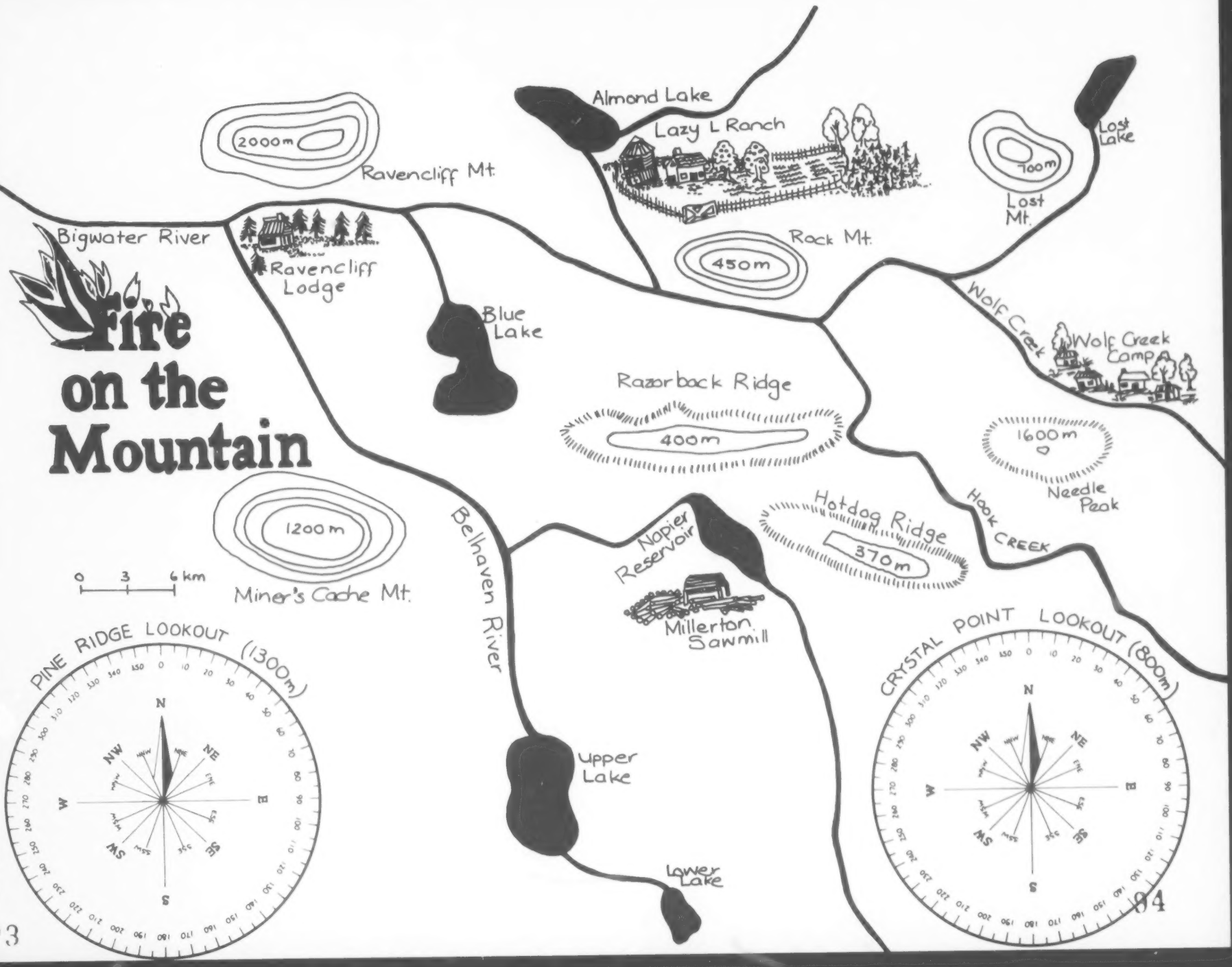

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fire lookout training sheet

	Crystal Point	Pine Ridge	Ravencliff Lodge	Ravencliff Mountain	Blue Lake	Miner's Cache Mt.	Lazy L Ranch	Rock Mountain	Millerton Sawmill	Wolf Creek Camp	Lower Lake
Crystal Point			307° 60 km								
Pine Ridge											

Directions:

Match locations on the chart and give compass degrees and distance by using the map.

degrees / distance

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Fire on the Mountain

You are a team of fire lookouts assigned to two different locations in the national forest. Part of your team will be at Pine Ridge Lookout and the other part at the Crystal Point Lookout Station. Both stations work together to spot fires, determine their severity, and alert necessary fire crews. Posted on the wall of each lookout station is a set of instructions listing available help and their locations.

Instructions

1. Ravencliff Lodge will have smoke billowing from a cooking fireplace. Four staff members are volunteer firefighters.
2. Miner's Cache Mountain has occasional campers and, as a result, some campfire smoke may be noted. There are no available firefighters in the area.
3. Millerton Sawmill will have a steady plume of smoke from their chip operation. There are eight available firefighters.
4. Wolfcreek Camp should be called if any smoke north of Needle Peak is noticed. A three-person fire crew and canoes are available.
5. Lazy L Ranch has eight people available for firefighting and a helicopter able to transport four people.
6. The distance between lookout stations is 56 kilometers.

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Daily Log

Fire on the Mountain

Team _____

MAY 7, 10:25 a.m.

Fire breaks out on the northernmost tip of Razorback Ridge. What are the compass readings from each lookout station?

_____

MAY 7, 1:07 p.m.

Pine Ridge Lookout spots smoke at 55 degrees and at a distance of about 70 kilometers. Crystal Point cannot make the same spotting. What could be a reason for this and what should be done?

_____

_____

MAY 7, 2:34 p.m.

Pine Ridge spots a fire at 20 degrees and Crystal Point at 291 degrees. What is the location of the fire?

_____

MAY 11, 4:31 p.m.

Fire is spotted at the southernmost point of Rock Mountain.

a. What is the compass reading for each lookout station?

_____

b. What is the closest lookout station?_____
What is the air distance between the closest lookout station and the fire?_____

c. Six people are needed to fight the fire. From where should they be dispatched?

_____

MAY 19, 8:34 a.m.

A concerned camper at Rock Mountain radios in about a column of smoke he sees due south. Pine Ridge plots it at 68 degrees, Crystal Point at 304 degrees. What will their report say?

_____

_____

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MAY 20, 9:04 p.m.

An injury has occurred at a fire located at 104 degrees from Pine Ridge and 250 degrees from Crystal Point. The fastest possible transportation will be needed to evacuate the firefighter to a point 56 kilometers to the south of both lookout points. What is your course of action?

MAY 24, 1:15 p.m.

A brush fire is reported and is located at 52 degrees from Pine Ridge and 330 degrees from Crystal Point. Ten firefighters and a helicopter are needed to fight the blaze.

a. Where is the blaze located?
b. From where will the firefighters come?

c. The helicopter will need to make repeated trips for water to fight the fire. What is the closest source?

How far is it from the fire?

MAY 24, 3:17 p.m.

Crystal Point Lookout reports a fire at 12 degrees and Pine Ridge also spots a fire at 12 degrees beyond Needle Peak. What can you determine about this situation?

The Forest Service has considered moving Crystal Point Lookout to a different location to better service the area it protects. What would be your recommendations and why?

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The Forecast For Today

I. Topic Area
Temperature mapping

II. Introductory Statement
Students will use newspaper weather reports to find the average high temperature, low temperature, and temperature range of their chosen city for one week.

III. Social Science Processes
Predicting
Locating/Organizing data
Interpreting data
Drawing conclusions
Comparing events
Relating to time

Science Processes
Predicting
Collecting/Recording data
Comparing
Interpreting data
Applying

Math Skills
Estimating
Finding averages
Line graphing
Bar graphing

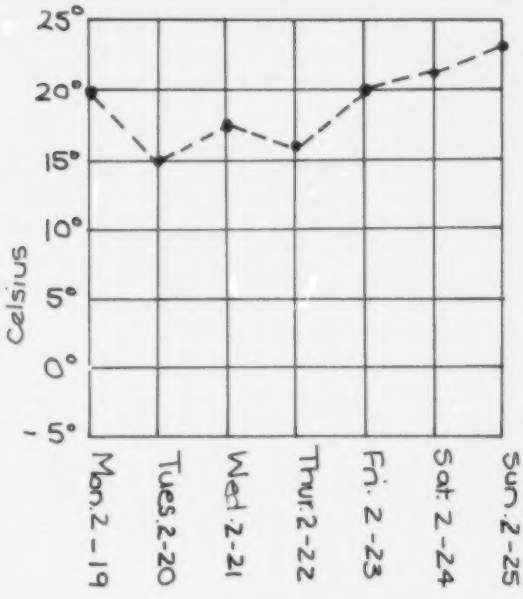
IV. Materials
Newspaper weather reports, 1 per student or group
Worksheets and graph
Colored pencils or crayons

V. Key Question
You are planning a trip to another city. How will you decide what clothes to pack?

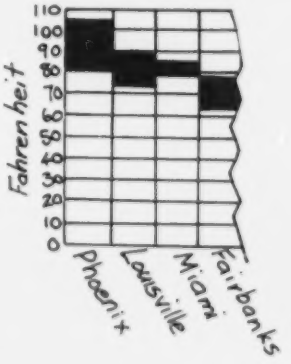
VI. Background Information
Most newspapers feature a daily weather report with high and low temperature readings for major cities in the state, the nation, and the world. A national temperature map is also included showing warm and cold fronts, rain, snow, etc.

This activity may be done with either Celsius or Fahrenheit measurements, depending on the availability of such information. Do not have students convert Fahrenheit to Celsius

To make a line graph, first identify the lowest and highest numbers to be recorded. Temperatures below zero mean that negative numbers, zero, and positive numbers are needed on the graph. How should the increments up the side of the graph be numbered? By 1's, 2's, 5's, 10's, or something else? If the range is small, the increments should be small. A wide range requires larger jumps. The bottom of the graph should show the days and dates. Record each temperature with a point. Using different colors or kinds of lines, connect the high temperature points with one line and the low temperature points with another. Finally, decide on an appropriate title for the graph.



The average temperature range graph should be constructed by marking the average high and low temperatures for each city and coloring the band between the two marks. It is an important skill to be able to read as much off of a graph as possible, so some time should be spent considering questions and hypotheses which go beyond the basic ones on the worksheet. By locating the cities on a map, hypotheses can be made about the causes of differences in the temperature ranges.



The long-range extension activity for comparing cities over a nine-month period is designed for the study of varied locations—Northern and Southern Hemispheres, inland and coastland—as well as seasonal changes.

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VII. Management

1. Daily newspaper weather reports can be brought in by students. Another option is to duplicate the necessary number needed each day. If possible, enlarge the small print before duplicating.
2. Saturday and Sunday information needs to be obtained from the weekend preceding or concluding the investigation.
3. Decide from which list or lists (state, national, world) students will choose cities. For example, a class studying U.S. history might want to choose cities across the nation.
4. Students may work individually or with a partner.
5. The initial activity will take 30 minutes or more. Students will then need 5-10 minutes per day to track high and low temperatures. The concluding computation, graphing, and discussion will take about 40 minutes. Another period should be spent comparing the temperature ranges for ten cities.
6. The number recorded in the temperature range column should be the difference between the high and low temperature.
7. The average temperature range graph should be constructed by marking the average high and low temperatures for each city and coloring the band between the two marks.

VIII. Procedure

1. Pose the key question. After discussion, focus on the importance of weather in making such decisions.
2. Introduce students to the features of a newspaper weather report. Ask what temperature measurement is used, Celsius or Fahrenheit?
3. Students will:
   a. Pick a city and predict its average high and low temperatures for the coming week.
   b. Research and record the physical geography of the city's location sometime during the week.
   c. Record their city's high and low for seven days. Optional—Have students create their own table for recording data.
   d. Compute the average high and low temperatures and temperature range.
   e. Make a line graph, using different colors for the daily high and low temperatures. (See Background Information.)
4. Lead a class discussion comparing results and concluding what clothes would be needed for each city.
5. Students will compare the average temperature range of ten cities from class data. Ask them to write a specific number of hypotheses based on the graph and map study. Discuss possible reasons for temperature range variations.

IX. Discussion

1. What clothes would you take if you were traveling to your chosen city?
2. Which city had the highest average temperature this week? The lowest?
3. Which day had the widest temperature range?
4. Was your temperature range close together or far apart? Why do you think that happened?
5. Predict the temperature in your city for next week. What might cause it to change from last week? (a change in air pressure systems, the movement of warm/cold fronts, etc.)
6. How does the geography of a region help determine a city's weather pattern? (The presence of water makes it more humid, deserts are hot and dry, mountains surrounding a valley reduce air movement, higher elevations are generally cooler, etc.)
7. What was the general temperature of _____ (state, country, world) over the week?
8. Compare the temperature of your chosen city with that of your home town.
9. Average Temperature Range Graph:
   a. Which cities differ by about ten degrees?
   b. What might cause the differences in average temperature ranges? (Look at city locations on a map. Geography [see question 6] and high and low pressure system patterns are two of the reasons.)

X. Extensions

1. Do a year-long study of world temperatures by picking six cities (one possibly your own) from each of the major continents. A variety of coastal and inland cities should be chosen. Record, on the sheet included, the temperature range on a certain day each month (Example: Sept. 5, Oct. 5, etc.) for nine months. On another paper, write ten conclusions about the information. Three or more should deal with what causes certain temperature ranges.
2. Using an enlarged state, national, or world map, students can create a temperature map showing the accumulated data for either average highs or lows. Together, devise a key depicting temperature ranges. Then give students a rectangle or circle on which they will draw the appropriate coded symbol or color for their city. The size will be determined by the size of the map. The papers can be glued or otherwise attached to the map, overlapping if necessary. Use for further discussion.
3. Research the origin of the names Celsius and Fahrenheit.
4. Have the students staple the weeks' newspaper weather maps in order and then flip through them to see a visual movement of weather.

XI. Curriculum Coordinates

Language Arts: Write a weather bulletin or forecast for the day or week and read as a television report. Have several students do one each day.

Science: For other activities related to weather, see the AIMS books *Overhead and Underfoot* and *Down to Earth.*

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The Forecast For Today

Names _____

_____

1. PREDICTED TEMPERATURES

Average High _____

Average Low _____

_____
Name of City

2. Research and describe the physical geography of this city (mountains, desert, forest; by ocean, lake, river; elevation; etc.)

_____

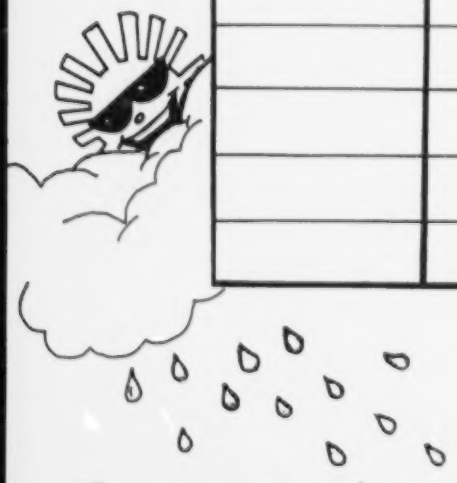
_____

_____

3. Using information in the newspaper, record the high and low temperatures for your city daily. Then find the average high, low and range for the week.

$$\text{Average} = \frac{\text{Total}}{\text{\# of days}}$$

DATE	DAY	TEMPERATURE		
		HIGH	LOW	RANGE
	TOTAL			
	AVERAGE			



4. If you were visiting this city tomorrow, what kinds of clothes would you pack?

_____

_____

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The Forecast For Today

LINE GRAPH

Name _____

KEY	
☐	HIGH TEMPERATURE
☐	LOW TEMPERATURE

_____ Title

DEGREES (Celsius, Fahrenheit)

DAYS OF THE WEEK

Temperature Range : _____

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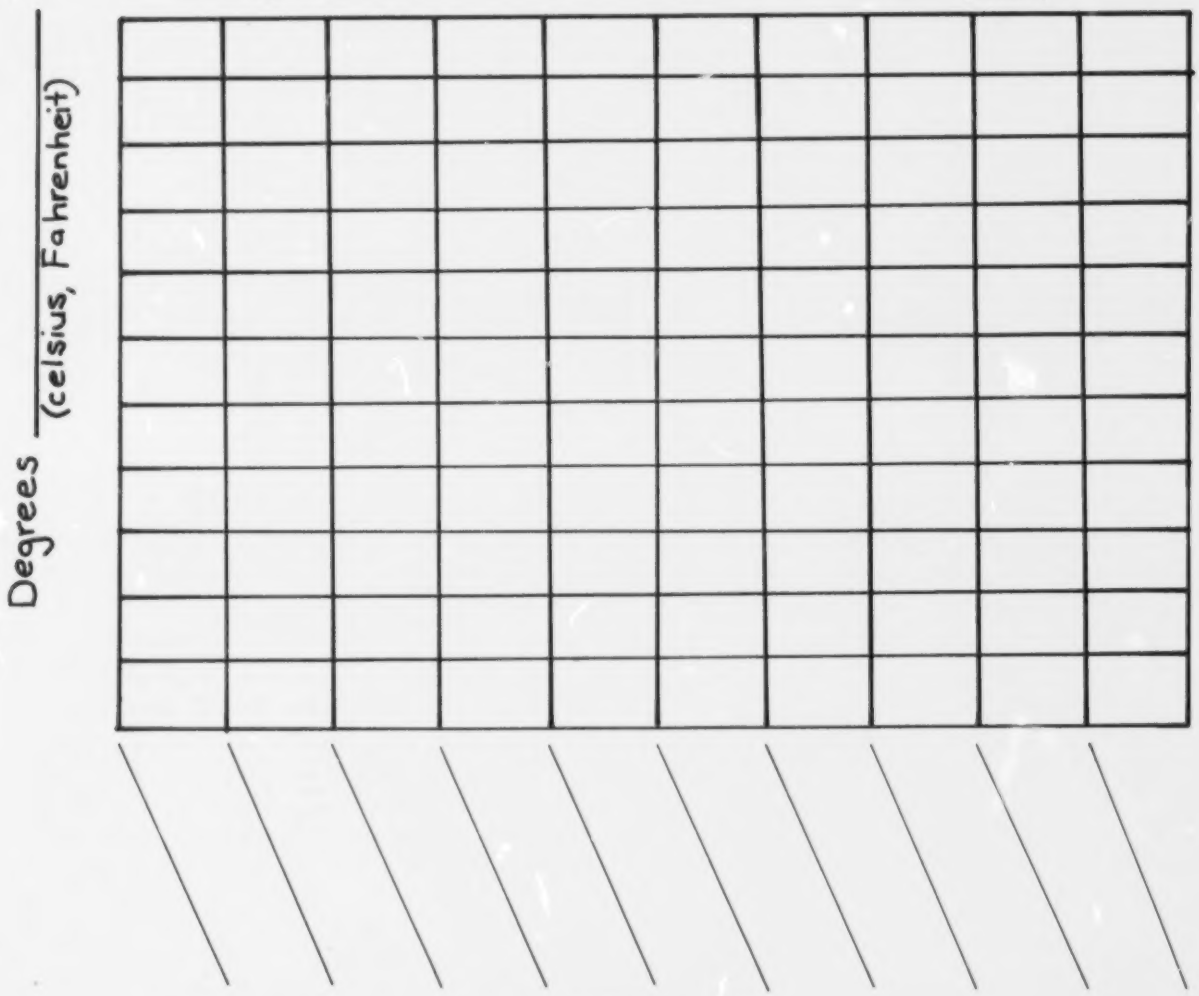
The Forecast For Today

Name _____

Collect information from other groups and record the average temperature range for ten cities during one week.

Average Temperature Range for _____ (week)



Which city has the largest range? _____

Smallest range? _____ Which cities have approximately the same ranges? _____

_____

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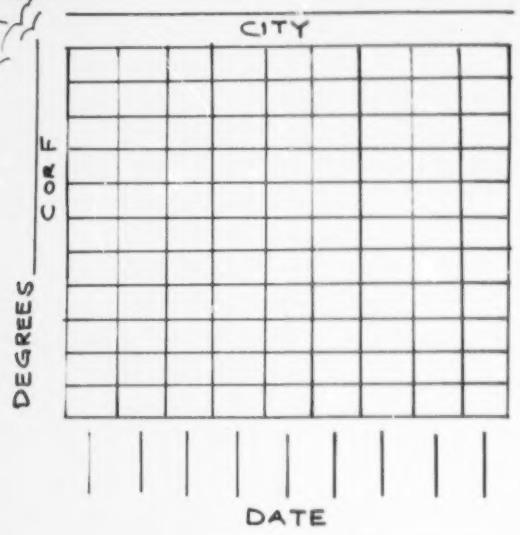
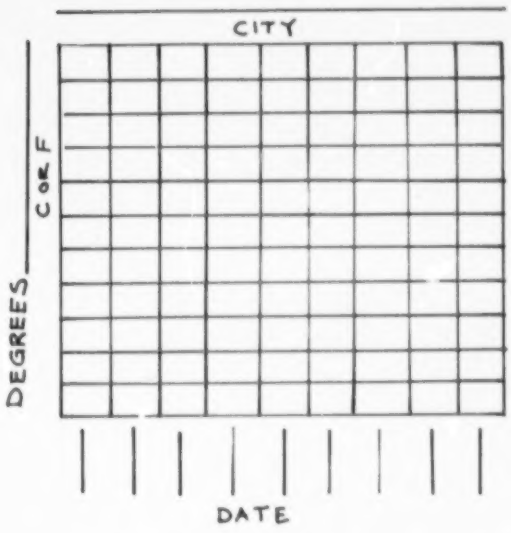
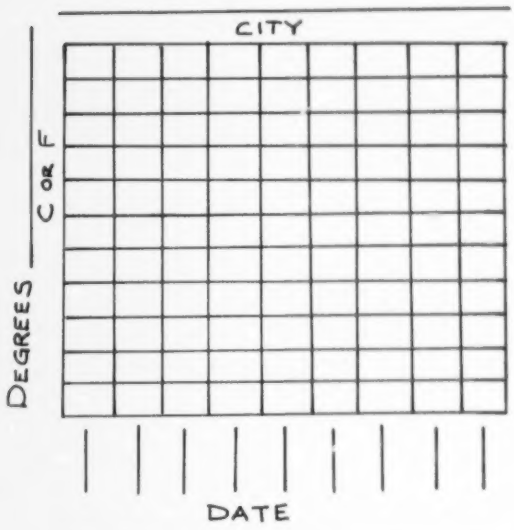
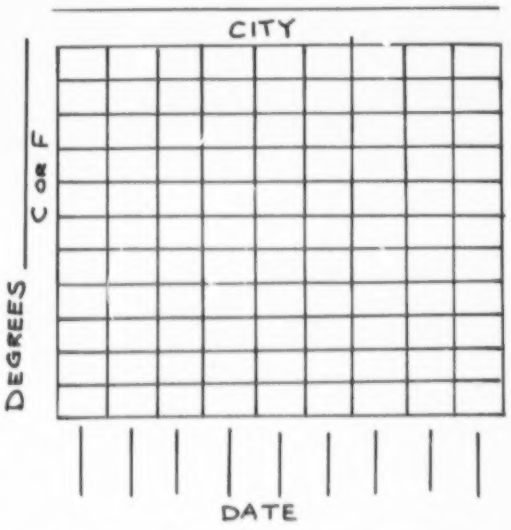
The Forecast For Today

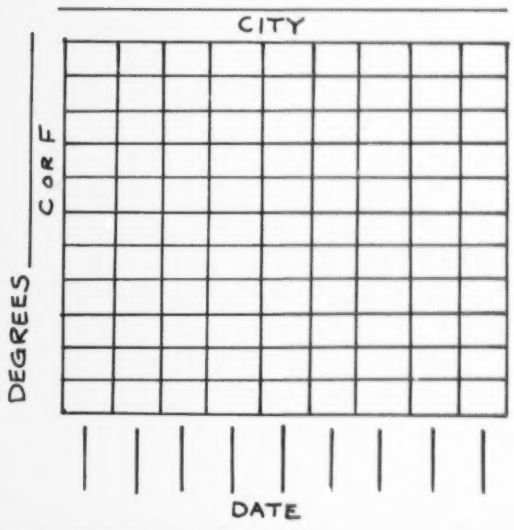
Name _____

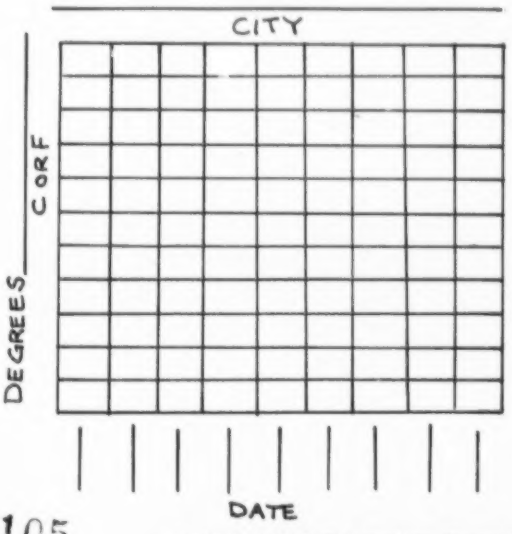












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People 'Plosion I

I. Topic Area
World population trends

II. Introductory Statement
Students will examine four decades of population data on the eleven most populous countries of the world and project their future growth.

III. Social Science Processes
Predicting/Hypothesizing
Making/Reading maps
Working cooperatively
Communicating ideas
Interpreting data
Comparing events
Relating to time
Appreciating rights/responsibilities
Solving problems

Science Processes
Predicting
Comparing
Inferring
Interpreting data

Math Skills
Estimating
Dividing
Sequencing
Graphing, line
Using a calculator
Rounding

IV. Materials
Worksheets
World maps in textbooks/atlases
Calculators
Colored pencils
Straight edge

V. Key Question
How fast is the world growing?

VI. Background Information
The subject of population trends can branch in many directions. This is a structured activity focusing on the world's most populated countries. An open-ended version, *People 'Plosion II*, follows.

We are an international community, numbering over five billion people. Because of our interdependence and the shrinking of natural resources, the population trends of the world are becoming increasingly important. Some of the issues raised involve moral or ethical considerations. The People's Republic of China, the most highly populated country in the world, has mandated that parents have only one child. The laws are set up to favor those who comply and discriminate against those who don't. Possible solutions to the world's problem need to be addressed by the generation now being trained.

It should be noted that the population of Pakistan decreased between 1969 and 1979. The cause of this was the 1971 split of West and East Pakistan, after a nine-month civil war, into two countries: Pakistan (formerly West Pakistan) and Bangladesh (formerly East Pakistan).

VII. Management
1. Students should work in pairs.
2. This activity may be divided into three periods: a) map; b) line graph and projected population; c) density, ranking, and discussion.

VIII. Procedure
Student pairs will:
1. Locate, color, and label the listed eleven countries on the world map.
2. Glue the line graph together and plot the population data on it. Use a different color for each country and label the lines.
3. Estimate the projected populations visually by continuing the lines on the graph to 2009. Be prepared to give the rationale for the slope of the lines drawn.
4. Record, in the table, the approximate projected populations based on the lines drawn.
5. Compute the population density for each country.
6. Compare the countries by ranking according to population and according to density.
7. Discuss the implications of the results.

IX. Discussion
1. Why did you draw the projected population lines the way you did? (used an average slope, used the slope between 1979 and 1989)
2. What factors change the population? (births, deaths, immigration)
3. Does past growth guarantee future growth? Why or why not?
4. Which continent appears to have the greatest share of the world's population? (Asia)
5. Which country has been growing the fastest?
6. Which was the decade of greatest growth for _____?
7. Has the rate of growth been fast or slow for _____?
8. How does density affect living conditions?
9. Why should we be concerned about population trends of the world? (world's resources, poverty, pollution, jobs, etc.) Is more better?
10. What solutions can you offer to solve the world's population problems? Do you agree with China's approach? Why or why not?

X. Extensions
1. Select three countries and write about the pattern of growth over four decades.
2. Figure the percent of growth each decade for each country.
3. Write for the current "The World Bank Atlas" to get a booklet with economic maps, life expectancy maps, etc. of the world. Address: The World Bank, 1818 H St., N.W., Washington, D.C. 20433, USA.

XI. Curriculum Coordinates
Math: One kilometer equals .621 miles and 1.609 kilometers equal one mile. Use community landmarks such as streets or businesses to illustrate the size of a square kilometer. Walk a kilometer. Tie in with a discussion of density.

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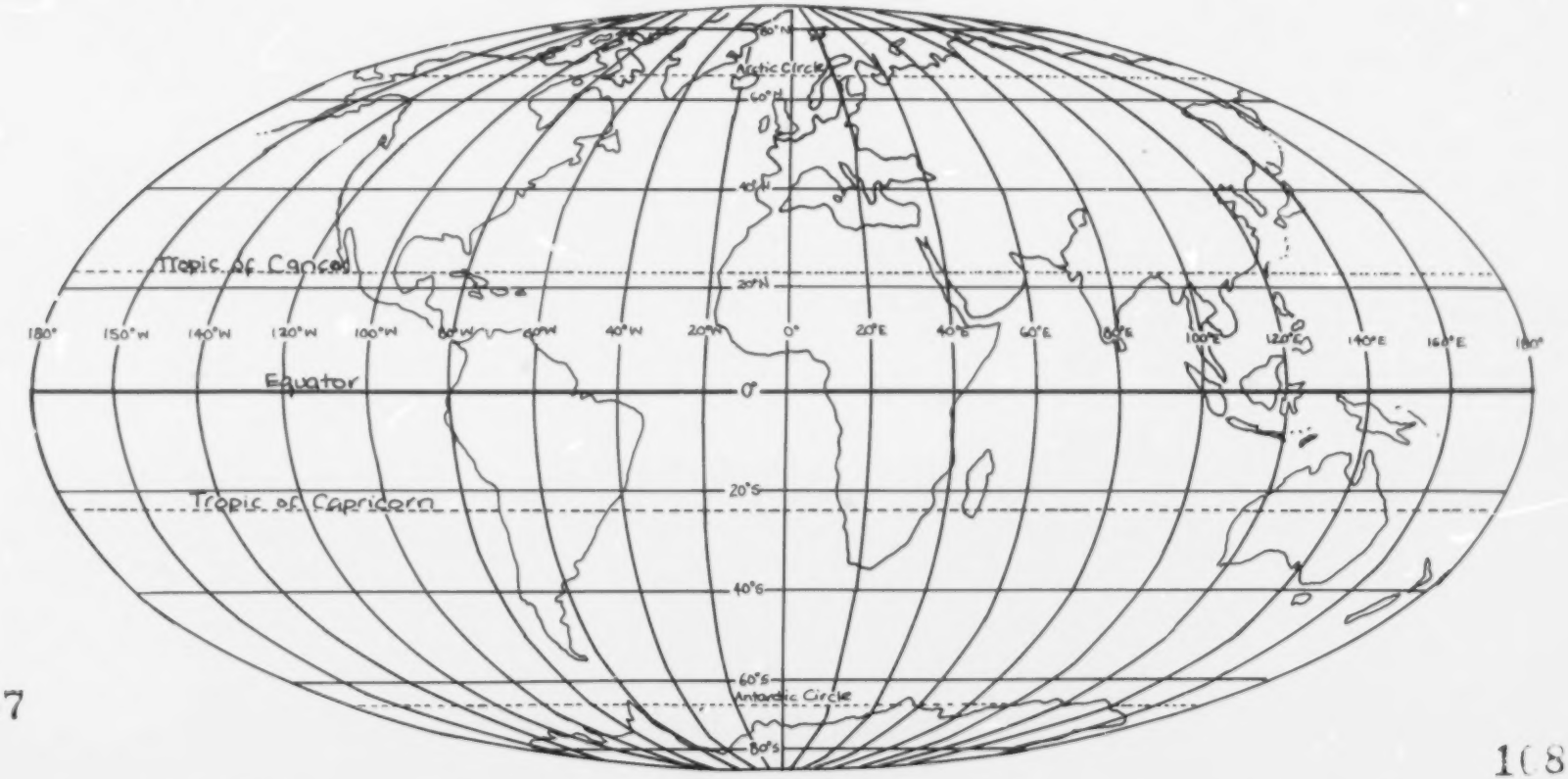
People Plosion I

Names _____

_____

Color and label the eleven most populated countries in the world.



107

108

Using the statistics and this map, which continent shows the greatest population?

_____

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People Posion I

Names _____

_____

THE WORLD'S MOST POPULATED COUNTRIES

COUNTRY	1959*	1969*	1979*	1989*	PROJECTED POPULATION** 1999	2009
Bangladesh	——	——	88,092,000	112,757,000		
Brazil	68,000,000	93,700,000	119,175,000	153,992,000		
China (People's Republic)	669,000,000	740,000,000	1,012,197,000	1,069,628,000		
India	402,750,000	536,938,000	667,326,000	833,422,000		
Indonesia	89,600,000	116,000 000	148,085,000	187,726,000		
Japan	92,740,000	102,322,000	115,880,000	123,231,000		
Mexico	34,625,903	48,313,438	65,770,000	88,087,000		
Nigeria	35,000,000	63,870,000	74,595,000	115,152,000		
Pakistan	88,211,000	132,000,000	84,075,000	110,358,000		
U.S.S.R.	208,826,000	241,748,000	262,436,000	287,015,000		
United States	179,323,175	200,255,151	222,020,000	247,498,000		

* The World Almanac and Book of Facts 1961, 1971, 1981, 1989. (estimates and census figures.)

** Transfer estimates from line graph.

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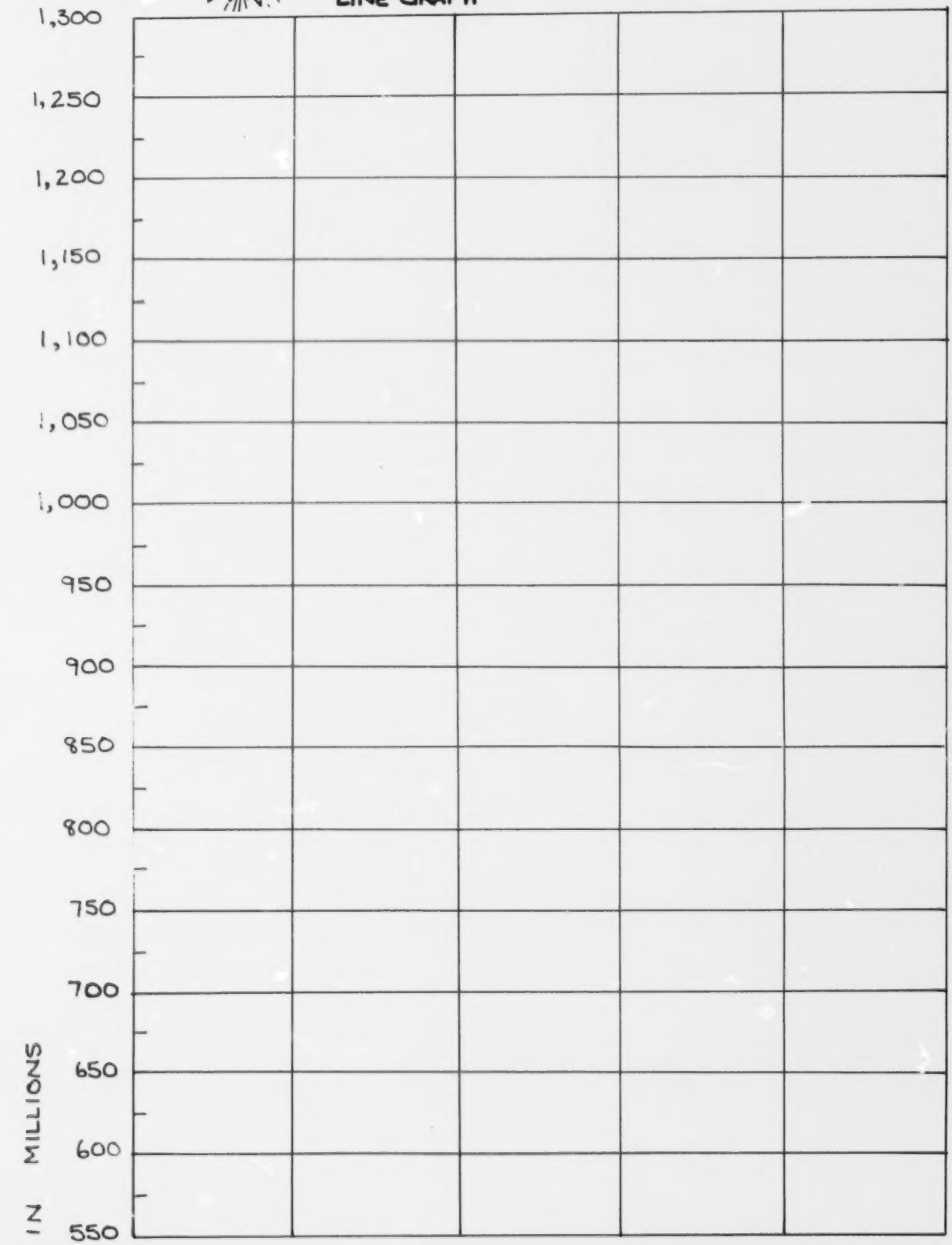
People Plosion I

Name _____

LINE GRAPH



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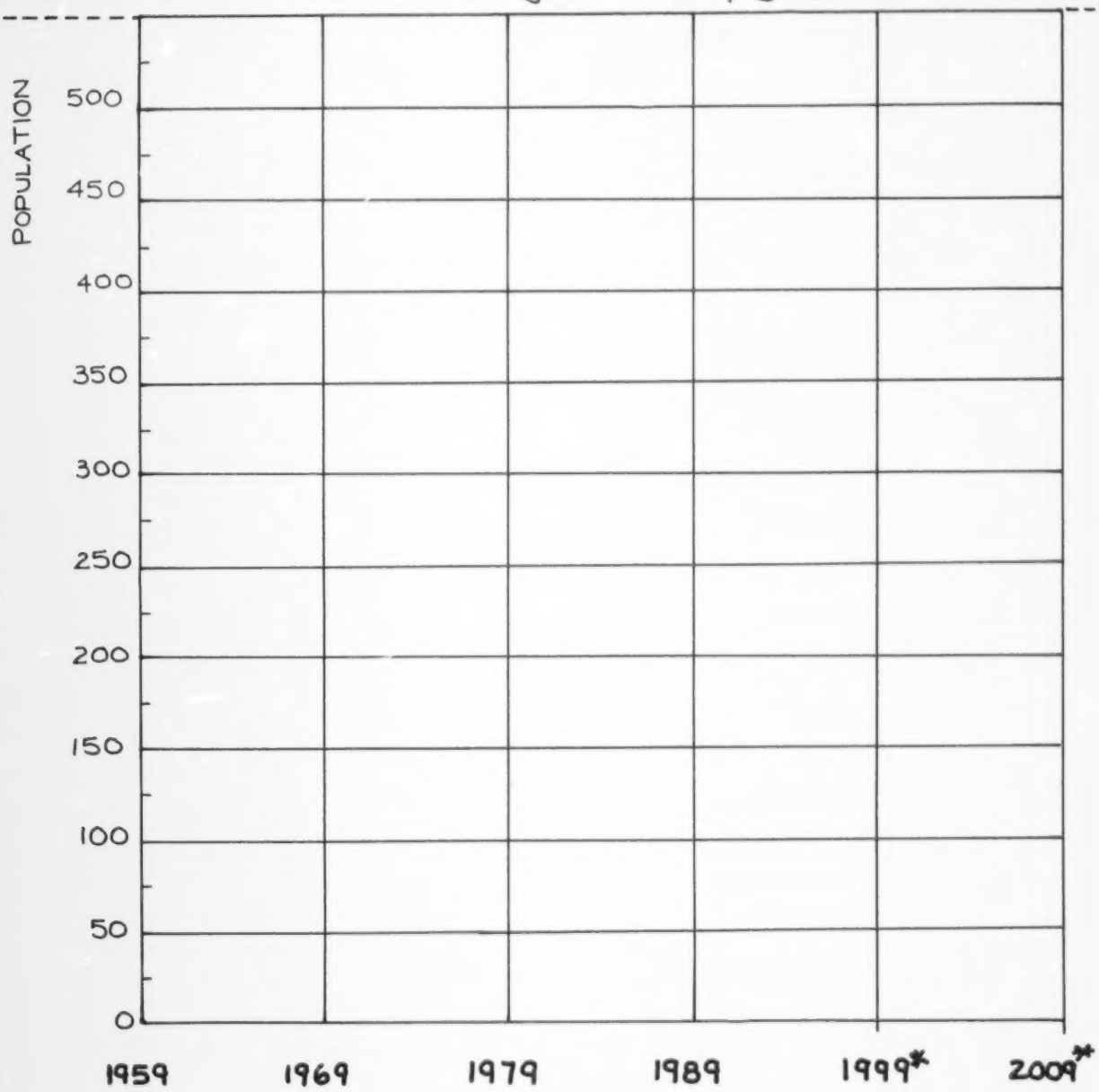
Cut and glue to rest of graph.



Why did you draw the projected* population lines the way you did?

Record your estimated numbers for 1999 and 2009 on the population table.

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People Explosion I

DENSITY

Names _____

_____

Density is the average number of people concentrated in a certain amount of space.

COUNTRY	1989 POPULATION*	AREA* (km^2)	DENSITY**
Bangladesh	112,757,000	89,457	
Brazil	153,992,000	5,287,930	
China (People's Republic)	1,069,628,000	5,961,973	
India	833,422,000	2,037,951	
Indonesia	187,726,000	1,183,046	
Japan	123,231,000	234,682	
Mexico	88,087,000	1,225,421	
Nigeria	115,152,000	573,877	
Pakistan	110,358,000	499,438	
U.S.S.R.	287,015,000	13,917,039	
United States	247,498,000	5,822,601	

*The World Almanac and Book of Facts 1989
(area figures converted from sq. miles to sq. km)

**Population ÷ Area (Because of calculator limitations, figure as in the example for Bangladesh: 112,757 ÷ 89.457)

Rank the above countries by:

POPULATION	DENSITY
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____
6. _____	6. _____
7. _____	7. _____
8. _____	8. _____
9. _____	9. _____
10. _____	10. _____
11. _____	11. _____

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People Plosion II

I. Topic Area
Population trends (generic)

II. Introductory Statement
Students will research past, present, and compute future population trends in the most highly populated locations in the world, country, or state. Possible choices include comparing continents, cities of the world, regions of the United States, states, U.S. cities, or cities within a particular state.

III. Social Science Processes
Predicting
Locating/Organizing data
Working cooperatively
Formulating questions
Communicating ideas
Considering multiple points of view
Appreciating rights/responsibilities
Relating to time

Science Processes
Predicting
Comparing
Collecting/Recording data
Inferring

Math Skills
Estimating
Dividing
Finding percent
Graphing, line
Using a calculator

IV. Materials
Resource books: almanacs, atlases, encyclopedias
Worksheet and graph
Calculators
Colored pencils
For extension: black line masters of state, country, or world

V. Key Question
What are the population trends in _____?
(state, country, or world)

VI. Background Information
This activity is designed to be used as an introductory lesson in population or as an in-depth study in sociology. Choose the area of study which will best meet your needs.

To expose students to global population issues, compare continents or the top ten cities of the world. Do the students know that the population of the world has passed five billion? How many more can the world handle, considering our resources? What about China's plan to limit each family to one child? Although the world's city boundaries are difficult to define and the various nations do not take censuses at the same time, patterns and observations are still possible.

If the focus of your study is the United States, a comparison of growth in the nine regions of the country (as recorded in the almanac), individual states, or the top ten U.S. cities is advised. One advantage to comparing states is that the almanacs generally list census data for every decade.

A study of state history might indicate research into the most populated cities within the state. Which ones are growing fastest? You might want to include your own city. Check the local Chamber of Commerce for information if it is not available elsewhere.

Data can be supplied by the teacher or researched by the students. Almanacs and encyclopedias are the best sources of information. They will give the land area, usually in square miles, and the current population. However, to get past populations for cities, a 20-year old almanac may need to be found at the local library.

Use the following formulas to complete student worksheets:

Density = Population ÷ Area

% of Total population = Specific population ÷ Total population
Example: Louisiana population ÷ Population of the U.S.

% gain = [Present population − Past population] ÷ Past population

% loss = [Past population − Present population] ÷ Past population

20-year projection =
[Current population x Gain or loss] + or − Current population

Births, deaths, and immigration are the three ways population changes. However, government policies (such as the People's Republic of China mandating only one child per family) and unexpectedly large groups of immigrants (such as those from Southeast Asia) can alter projected figures. A simple percent based on past history is a beginning way to predict the future population, but the field is really much more complex.

VII. Management
1. Determine which type of locations the class will study. See Background Information.
2. The amount of time necessary to complete this activity will depend on how much research the students will do themselves.
   a. Locating information and recording without teacher assistance will take two 50-minute periods.
   b. Completing the table with calculators will take another 50 minutes.
   c. The graph and discussion will take at least 40 minutes.

VIII. Procedure
Student groups will:
1. Conduct research to find the past and present populations and areas of the locations chosen, or the teacher will supply the same data. Area should be recorded according to the measure-

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ment used in the resources. Do not convert square miles into square kilometers.
2. Figure the percent of gain or loss and use it to make the 20-year projection.
3. Compute the density of past, present, and future populations.
4. Determine the % of total population (see Background Information) for past, present, and future populations. This column may not be applicable in some cases and can be left blank.
5. Answer the questions on the worksheet.
6. Make a line graph showing the population trends, using a different color for each location.
7. Formulate their own questions and discuss the results.

IX. Discussion

The ideal situation would be for students to generate these questions on their own. A sample question to stimulate this might be: "After completing your research, you will have learned many things that have not been asked. From your results, what questions can be answered?"

1. Has the number of people living in (*U.S. cities, etc.*) increased or decreased over the stated years?
2. Does growth over the past 20 years guarantee growth over the next 20 years? (No.) Why or why not? (Changes in number of births, deaths, and immigrants; physical space; jobs; etc.)
3. How does population density affect living conditions?
4. How does population affect representation in Congress? (Every state has two Senators but the number of Representatives are determined by population. After each census, adjustments are made whereby some states gain Representatives but others may lose them.)
5. Which *states, cities, etc.* show natural restraints affecting future growth?
6. Which physical features may promote growth?
7. Will growth reach the saturation point?
8. Where are the heaviest concentrations of population?
9. How will continued growth affect the world's natural resources?
10. How can growth be slowed down or speeded up? How would your solutions affect people?

X. Extensions

1. Using a teacher-provided map outline, have students locate the places in their data table.
2. Students can draw a pictograph map indicating the density of each location. A key should be added.

XI. Curriculum Coordinates

Writing:

1. If given the opportunity, and considering your projected findings, which metropolitan area would you choose to live in and why?
2. Write letters to the Chamber of Commerce of each metropolitan area to compare population projections and to see what programs each city has to promote smooth growth increases.

Art:

1. Draw an advertisement to lure people to your city, state, or continent.
2. Draw a cartoon of a saturated city.

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People Plosion II

Names _____

LOCATION	AREA: SQ. _____	PAST - 20 YEARS AGO			PRESENT			% + OR -	FUTURE - 20 YEARS PROJ.		
		POPULATION	DENSITY	% OF TOTAL POP.	POPULATION	DENSITY	% OF TOTAL POP.		POPULATION	DENSITY	% OF TOTAL POP.

Which location will show the most growth in 20 years? _____ The least growth? _____ Which location consistently shows the greatest density? _____

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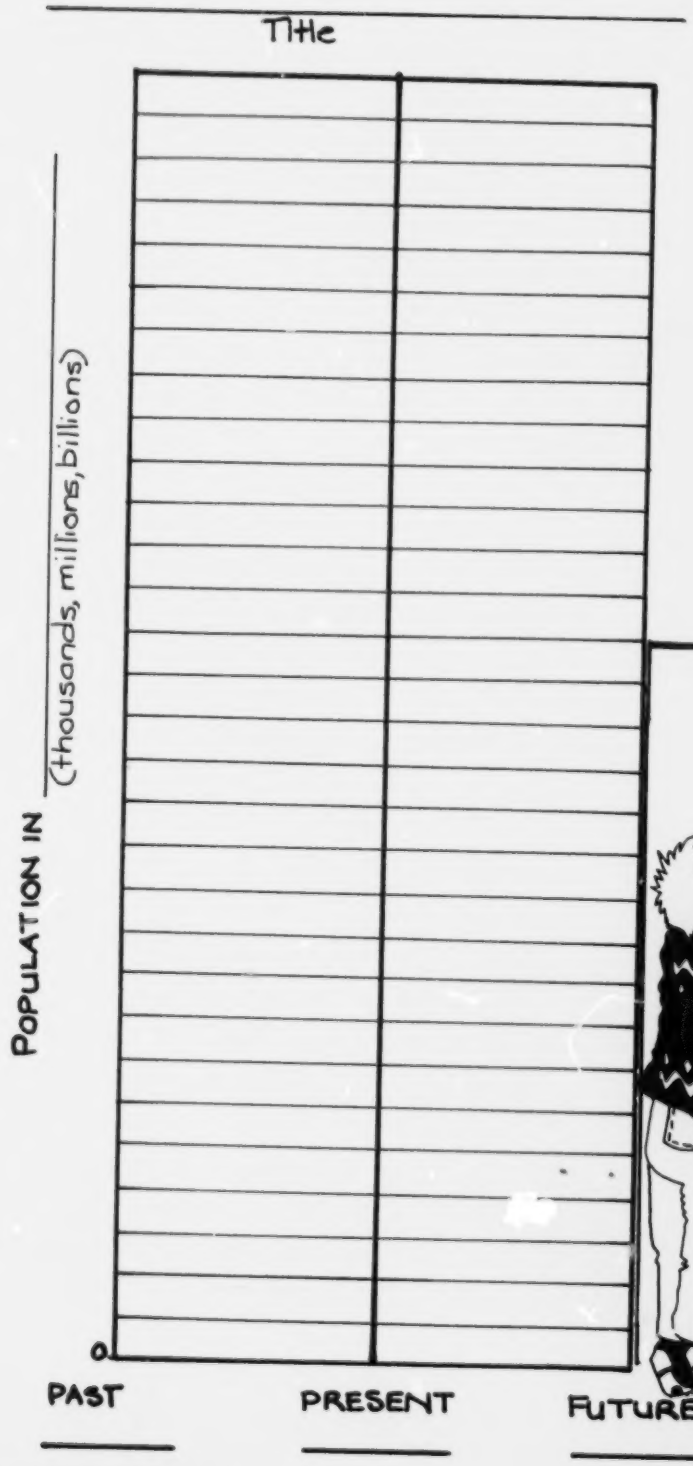
People Plosion II

LINE GRAPH

Name _____



1. Write the years under past, present, and future. Example: 1970, 1990, 2010

2. Plot the three population figures for each location and connect with a line. Use a different color for each location. Label the line.

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Count me in!

I. Topic Area
Taking a census

II. Introductory Statement
Students will use a random sample to determine the population of a given area.

III. Social Science Processes
Hypothesizing
Working cooperatively
Interpreting data
Drawing conclusions
Communicating ideas
Comparing events

Science Processes
Inferring
Collecting/Recording data
Controlling variables
Measuring/Comparing

Math Skills
Measuring length
Computing area
Counting
Finding averages
Using calculators, optional

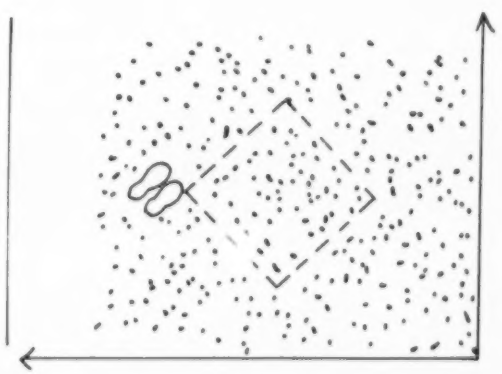
IV. Materials
Worksheet
Two 1-lb. bags of lima beans
40 meters of string
4 meter length of string, 1 per group
Meter sticks, long meter tape, or trundle wheel
Watch or clock that can measure seconds
Calculators, optional

V. Key Question
How can a person estimate large numbers without actually counting them?

VI. Background Information
See the fact sheets "Taking a Census" and "Random Sampling".

VII. Management
1. Plan at least one hour for discussion of the concept and the activity. Final discussion and applications will depend on the needs of the individual class.
2. Cooperative learning groups of 4 or 5 are recommended. One person should be the group walker and the remaining team members will use string to outline the sample area and count the beans within it. Each team member should be responsible for recording the data at least once during the repetition of the sampling exercise.
3. Time should be allowed to discuss the findings of the sampling exercise and its impact on census taking as well as other possible uses this exercise could have.
4. Outline the census area, preferably grass, with string or pylons before students arrive. A 10 × 10 meter area is easiest mathematically, but other square or rectangular measurements may be used. Distribute all of the beans over the area in a random manner. Don't forget the corners!

VIII. Procedure
1. *The teacher will:*
   a. Set up the problem of census taking. A question such as "How is it possible to count how many people there are in the world?" should be used to stimulate interest and allow students to buy into the problem. Allow students to make guesses as to how a census or opinion poll is conducted.
2. *Student groups will:*
   a. Cut a 4-meter length of string and mark each meter.
   b. Measure and record the length and width of the census area to determine the total area. Length × width = square meters.
   c. Line up along the perimeter of the census area and each send one walker to the middle of the area.
3. *The teacher will:*
   a. Direct the walkers to walk aimlessly about the area. They must stay inside the boundaries and not walk with another person. Walking with closed eyes may help the sample be truly random, but another team member should help the walker avoid bumping others.
   b. Tell the walkers to stop and freeze after 30 seconds.
4. *Student groups will:*
   a. Go to their walker and outline a square meter at the walker's right foot with the 4-meter string. The meter marks identify the corners.



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b. Count (2-3 group members) the beans in the sample area. The remaining team member should record the data.
c. Repeat steps 3 and 4 two more times.
d. Clean the area by picking up the beans and boundary markers. This may be postponed until after the class discussion, if desired.
e. Find the total, average, and projected population based on their samples. Average × (total area/area of sample) = projected population.
f. Report their results to the class so the data can be recorded in the table and compared. Optional—If more math practice is desired, groups can report their samples and everyone figure the total, average, and projected total population for all groups.

5. The teacher will lead a discussion on the accuracy and problems with this method of census taking.

IX. Discussion

1. What are some positive points about a random sample census? (quick, easy, relatively accurate) Negative? (not 100% accurate)
2. How do your results compare with other group results?
3. What are some factors that may have led to inaccuracies in our random sample? (how evenly the beans were dispersed, beans overlooked because of the height of the grass, etc.)
4. How are some of the difficulties we experienced similar to real problems in a random sample? For example: If some beans were hidden by tall grass, could that be related to the real problem of finding every residence in a rural or urban area? (Problems that surfaced in the 1990 U.S. census, which attempted to count every person, were lack of cooperation, illiteracy, language, finding the homeless or those with no mail address, etc.).
5. Why was it necessary to choose three samples in the one area and find an average? (The more samples, the more accurate the results.)

X. Extensions

1. Invite a pollster to class to explain the process of polling the general public.
2. Gather examples of polls published in such sources as news magazines. Make note of the sampling error.

XI. Curriculum Coordinates

Language Arts: Design an opinion poll questionnaire about some subject of interest such as favorite pastime activities at your school. Use random sampling to compile statistics.

Computer: Make and use a survey with a program such as "Survey Taker" from Scholastic.

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Count me in!

Group — Names:

Area of sample: _____ m^2

Total area of population: _____ x _____ = _____ m^2

	GROUP RESULTS							
SAMPLE	A	B	C	D	E	F	G	H
1								
2								
3								
TOTAL								
AVERAGE								
PROJECTED TOTAL POPULATION								

Using your group's average, determine the population of the total area.

_____ x _____ = _____

How do your results compare with other group results?

_____

_____

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Taking a Census

A census is a survey conducted by a nation's government to gather information about its people. At least 90% of the world's nations conduct some kind of census. Some countries only conduct a population census. Others, like the United States, conduct a census with many questions. Information gathered in a census may include population, housing, agriculture, government, construction, manufacturing, mineral industries, and transportation. Other information gathered about the general population may include age, employment, income, sex and race.

The first American census was taken in 1790. The enumerators, people who did the actual counting, surveyed the country on horseback. It took 18 months to count the nearly four million people then living in the U.S. Taxes and congressional representation were determined from this information.

The way a census is conducted depends on the information that needs to be gathered. For a population census, the Census Bureau tries to reach every household. For other types, the Bureau surveys a representative sample. Every fourth or fifth home may be contacted about certain information and the results will be adjusted to apply to the entire population.

Some nations with expansive unpopulated areas will use a representative sample to determine the population of the entire area. A large area is divided into smaller regions. Then specific regions are chosen by chance and every person in the region is questioned. The results are multiplied by the number of regions in the area to determine a total number.

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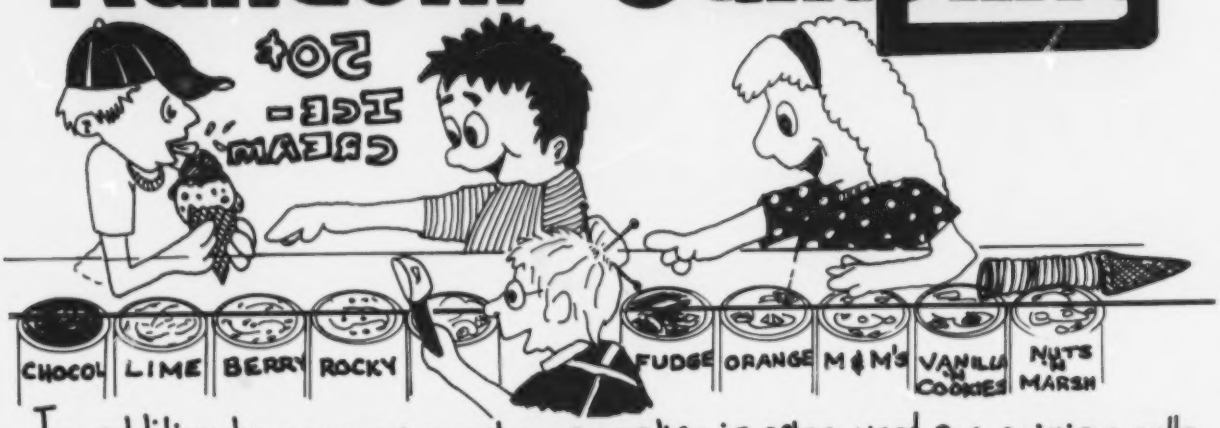
Random Sampling



In addition to a census, random sampling is often used for opinion polls. The topic of an opinion poll might be how people feel about a Presidential candidate or current world, national, or local issues.

Two rules must be followed to obtain a random sample. 1) The size of the sample must be large enough to show reliable results. 2) The sample must be random; all members of the population must have an equal chance of being chosen.

Every random sample has a sampling error, found with special formulas, which determines its accuracy. For example, if a sample produces an estimated population of 1,367 and the sampling error is plus or minus 5, the actual population could be between 1,299 and 1,435. The actual results could be as much as 5% more or less than those given. The greater the sampling error, the less accurate the results.

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Tic Tac Room

I. Topic Area
Room grid

II. Introductory Statement
The students will locate items in their classrooms using a life-size grid.

III. Social Science Processes
Reading maps
Working cooperatively
Communicating ideas

Science Processes
Collecting/Recording data
Measuring/Comparing

Math Skills
Estimating
Measuring
Using map coordinates

IV. Materials
Worksheet
Meter sticks
20-30 sheets of 8½" x 11" paper
Masking tape
Per group: One length of string greater than the room's length, optional

V. Key Question
How can we find places on a map?

VI. Background Information
Many maps are set up on a grid system. Used in conjunction with an index, streets, cities, mountains, and other places can be located more easily.

A map grid differs from the graphing of ordered pairs in at least two ways. First, the starting point (A-1) on a map is in the upper left corner. The letters and numbers may go in either direction. The starting point on a graph is either in the center if there are four quadrants or in the lower left corner if only the first quadrant (x and y both positive) is used. Second, it is the area between the lines that is important on a map. Geographic locations often cover an area larger than a point, a street for example. The identifying letters and numbers are written in the spaces between the lines. In contrast, a graph is numbered at the lines and there is a specific point that is plotted along the *x* and *y* axes.

Longitude and latitude lines form a special kind of grid system of the world. The area between the longitude lines becomes smaller as one approaches the North or South Pole and is largest at the Equator. Latitude lines remain an equal distance from each other.

VII. Management
1. Groups of three or four are recommended.
2. Use 20 cm strips of masking tape to mark meters along the length and width of the room. Position them high enough so they are visible from anywhere.
3. Number and letter labels should be mounted *between*, and at the same height as, the meter marks.

4. If there are multiple objects of the same type, such as windows, specify which one is to be identified. Also discuss with students how to identify objects in more than one grid.
5. If students have difficulty estimating the grid coordinates, string can be used. One person holds the string at the object while another stretches it perpendicular to one wall and parallel to the other. Since strings can get tangled and knotted, the grid coordinates can also be determined by having a person walk to the wall in line with the object.

VIII. Procedure
The teacher will:
1. Determine the starting corner. Two options are available depending on which direction is faced.

The students will:
2. Measure and mark the meters along the length and width of the room.
3. Make large (8½"x11") letter/number labels and mount them between meters.
4. Locate and label the coordinates of the teacher's desk as a class.
5. Agree upon and record classroom objects to be added to the list.
6. Work in small groups to identify the coordinates of various objects in the room.
7. Discuss the results.

IX. Discussion
1. Is this method better than "It's over there."? Why or why not?
2. Compare this with a road map. What are the similarities and differences?
3. What are the differences between a map grid and a coordinate graph? (See Background Information)

X. Extensions
1. Use the grid system on a map, possibly one of the local city. Try to get a map for each group; check with the Chamber of Commerce. If given a location, name the grid position (E-5). If given the grid position, find the street or other object in question.
2. Take an existing map and make grids. Find various locations.
3. Play "Battleship", the game or the computer simulation.
4. Sponge activity: Give students directions such as "Jose, stand in B-7", "Where is the globe located?", or "Name an object in G-1".

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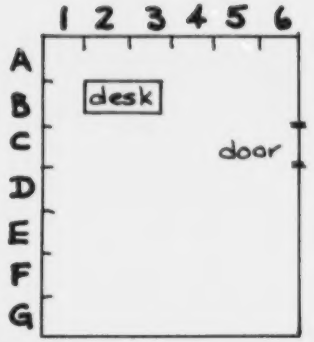
Tic Tac Room

Group _____

Measure and label each meter along the length and width of your room. Label one side with letters and the other with numbers.

In the example, the door is located at C-6 and the teacher's desk is at (B-2 , B-3)



Identify the grids in which the objects below are located. Every grid should be listed, separated by commas, for objects located in more than one grid (see example).

Door	_____	Cabinet	_____
Teacher's desk	_____	Wastebasket	_____
Chalkboard	_____	Bulletin Board	_____
Window	_____	_____	_____
Pencil Sharpener	_____	_____	_____
Electric Outlets	_____	_____	_____
Sinks	_____	_____	_____
Lightswitch	_____	_____	_____

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Scale the Room

I. Topic Area
Scale drawing

II. Introductory Statement
The students will map their classroom or another room to scale.

III. Social Science Processes
Making maps
Working cooperatively
Communicating ideas
Organizing data

Science Processes
Collecting/Recording data
Measuring

Math Skills
Measuring
Rounding
Computing scale ratios
Using calculators

IV. Materials
Worksheet and 1/2 cm graph paper, included
Meter sticks
Metric rulers
Calculators, optional

V. Key Question
How can we fit this room onto a piece of paper?

VI. Background Information
The scale format used by The National Geographic Society has been chosen for this book. Where a metric or standard length is used for actual and scale dimensions, a ratio is written first. Then a number comparison is written to the unit of measurement.

Example: 1:50 or 5 centimeters to the millimeter

When a non-standard measurement such as walking steps is converted to metrics, the ratio is omitted.

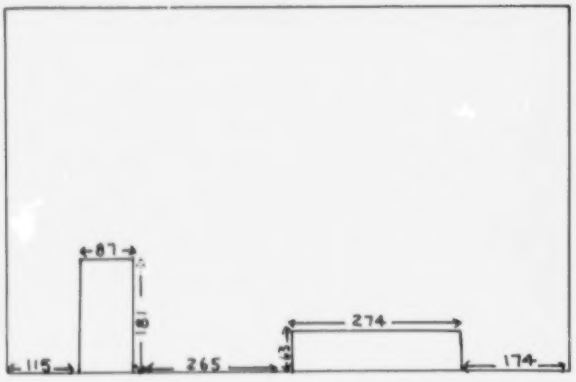
Example: 5 steps to the centimeter

To figure the scale, develop a ratio between the room length and the graph paper squares. If the length is 976 centimeters and the graph paper is 46 squares long, a good ratio might be 1:50 or 5 centimeters to the millimeter. This makes it easy to deal with remainders.

How was this figure determined? If 976 is divided by 46, the answer is 21.22. So the ratio must be at least 22 cm to a square. Since it is easier to count by 25's than 22's and it is evenly divisible by 5 mm, 25 cm is a good choice. Another choice might be 30 cm.

Some of the items to consider for the classroom include bookcases, the teacher's desk, tables, student desks, the sink, a file cabinet, and closets. The placement of doors, windows, and chalkboards is also part of a complete map.

Specific items are not difficult to measure, but what about their distance from each other or a door? It is helpful to draw a rough scale map on scratch paper. If all the measurements are shown on this paper, only the scale section of the worksheet may be needed.



Rough scale drawing in centimeters

VII. Management
1. Choose the room to be drawn to scale. The classroom has obvious advantages but, if the amount of furniture seems too much to handle, identify a few specific items with which students are to work. Other rooms such as the library or office may also be chosen. Be sure to make arrangements with the school personnel involved.
2. Divide the class into mixed ability groups of three or four. Group jobs might include:
   Recorder—writes down the items and measurements
   Checker—keeps the group on task, verifies accuracy of recorder
   Workers—take measurements and do computation
3. Possible set-ups:
   a. Give each group a section of the classroom to map to scale. Combine these into one map.
   b. Have each group map the entire room to scale.
4. All measurements should be done in centimeters rather than meters because the scale

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will relate to centimeters.

5. An alternative method for measuring and figuring scale applies to rooms which have square floor tiles. Each tile could represent one square on the graph paper. Glue graph paper together, if needed, to get the dimensions of the room. All measurements will be in number of square tiles.

VIII. Procedure

The teacher will:

1. Give students some practice with measuring and converting to scale before starting.
2. Discuss which items should be represented on the map and have students record them in the first column.

Student groups will:

3. Measure and record the length and width of the items listed. Measurements may be recorded on the worksheet or directly on a rough sketch of the room.
4. Agree upon a scale as a class or within individual groups.
5. Convert measurements to scale and record on the worksheet.
6. Construct a scale drawing of the room, starting with the perimeter.
7. Discuss and compare results.

IX. Discussion

Before:

1. What items should be included on our map?
2. What are some possible problems you might have gathering information? What are some solutions to these problems?

After:

3. What professions use scale drawings? (cartographers, architects, contractors, landscapers, car designers, etc.)
4. Compare the problems a class might encounter with those of a builder or another professional.
5. How can knowing how to make a scale drawing be useful to you? (planning where to place furniture before moving into a place, etc.)

X. Extensions

1. Draw a room of your house to scale.
2. Select an object from a period of history being studied and draw it to scale. Examples: Mayflower, Statue of Liberty, Egyptian pyramid, Acropolis
3. Save the scale drawing and use it for *Room to Move.*

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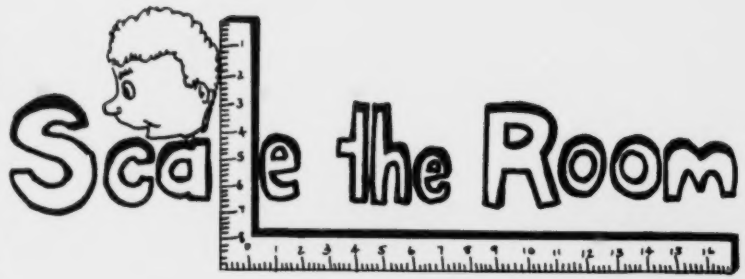

Scale the Room

Names _____ _____ _____ _____

1. Measure and record the information needed.
2. Decide the scale: _____ to the _____.
3. Compute the dimensions of each item to scale.
4. Draw the room to scale on the graph paper.

ITEM	LENGTH	WIDTH	SCALE LENGTH	SCALE WIDTH
ROOM				

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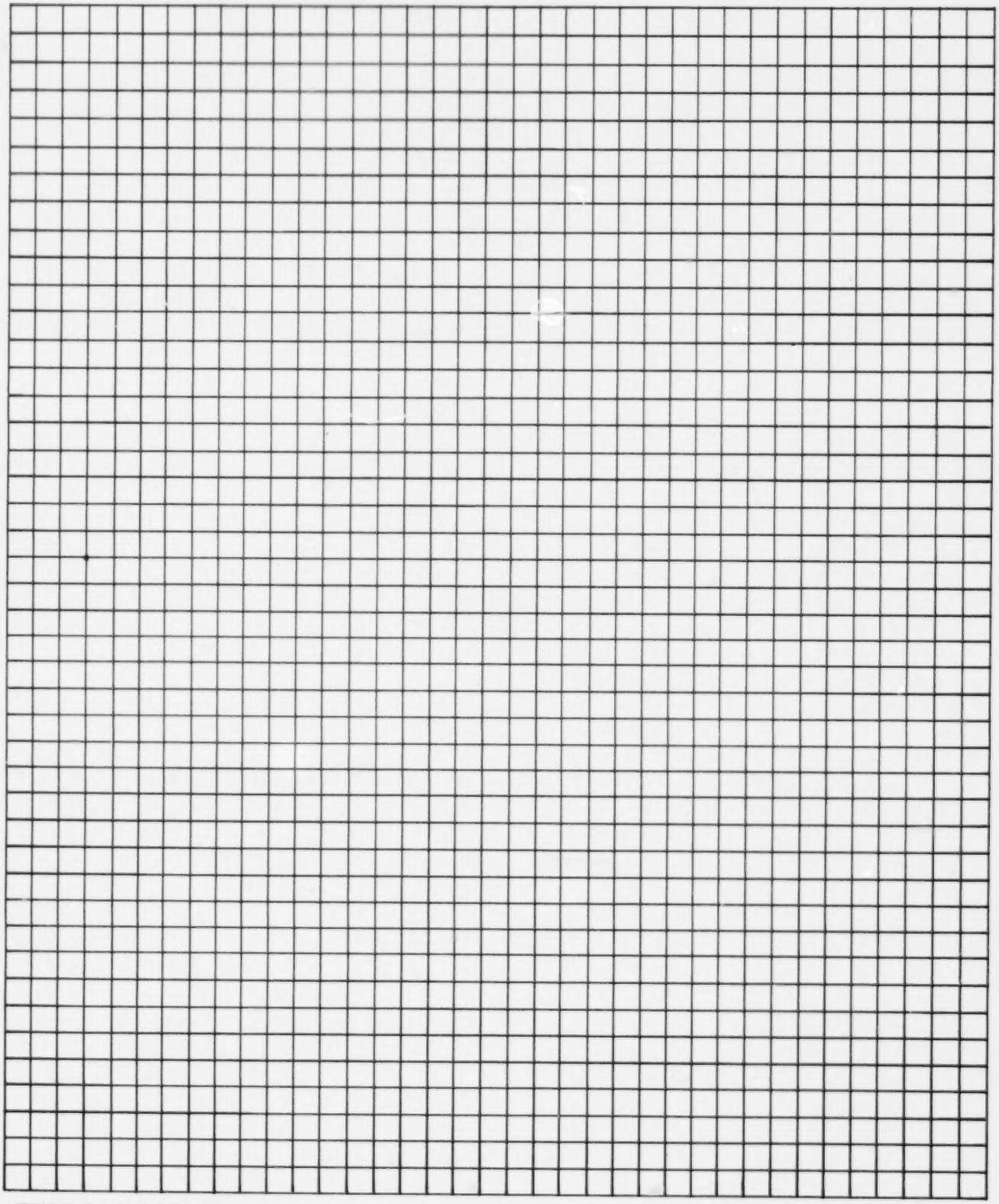
Map Title

Scale _____ to 5 millimeters

_____ to the millimeter

Names



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Room to Move

I. Topic Area
Room arrangement

II. Introductory Statement
Students will measure their classroom, take inventory of its furniture, and create an arrangement which maximizes floorspace.

III. Social Science Processes
Making maps
Communicating ideas
Working cooperatively
Solving problems
Considering multiple points of view

Science Processes
Measuring/Comparing
Identifying/Controlling variables
Collecting/Recording data

Math Skills
Measuring
Computing scale ratio
Rounding
Problem solving

IV. Materials
Worksheets
1/2 cm graph paper master from *Scale the Room*
Meter sticks
Metric rulers
Scissors
Glue sticks
Calculators

V. Key Question
How will you arrange this room to best meet our needs?

VI. Background Information
When planning where to place furniture, the uses of the room and needs of the people using it must first be identified. Classroom considerations might include traffic patterns between desks, access to sink and storage areas, and special tools such as computers, trash cans, and files. Typical classroom desk rows, if used, should be at least 76 cm apart.

To figure scale, divide the length of the room by the number of squares along the length of the graph paper. For example, if the room is 976 cm long and the paper has 46 squares, the answer is 21.2. This means the ratio must be at least 22 cm to a square to fit on the paper. Twenty-five cm is a good choice because it is easier to count by and is divisible by 5 mm (the length of the square). Another choice might be 30 cm.

The scale format used by The National Geographic Society has been chosen for this book. Where a metric or standard length is used for actual and scale dimensions, a ratio is written first. Then a number comparison is written to the unit of measurement.

Example: 1:50 or 5 centimeters to the millimeter

When a non-standard measurement such as walking steps is converted to metrics, the ratio is omitted.

Example: 5 steps to the centimeter

VII. Management
1. Groups of four are suggested. Job descriptions might include pattern cutter, inventory manager, data recorder, and math technician.
2. Allow 50 minutes or more for initial discussion, inventory, and measuring.
3. The time needed to figure scale and prepare patterns will depend on student abilities and the patterns needed. Average-sized furniture patterns are included so students can focus on arrangement rather than scale drawing. Where furniture differs significantly, patterns will need to be prepared to scale. The patterns given are drawn to a scale of 1:50 or 5 centimeters to the millimeter. If students have done *Scale the Room*, those pieces may be cut for use in this activity.
4. Allow 40 minutes or more for arranging and voting on the best arrangement. Additional time should be allotted to move the furniture into the winning arrangement.

VIII. Procedure
1. The teacher will guide a discussion of things to consider when arranging furniture.

Student groups will:
2. Measure and record the length and width of the room in centimeters. Round all measurements to the nearest centimeter.
3. Take inventory and measure the furniture in the room.
4. Find the scale dimensions, particularly of those items needed to supplement the patterns given.
5. Draw additional patterns and cut the number needed as recorded on the inventory.
6. Arrange the furniture patterns, considering the things discussed.
7. Glue the patterns on the graph paper after determining their best arrangement.
8. Present their arrangement to the class. The class will then vote on the best arrangement.
9. Implement the winning arrangement so the class can evaluate the efficiency of the new design. (optional)

IX. Discussion
1. What are the specialized needs of the room being arranged? (i.e., band room vs. art room—answers will vary)
2. What are the traffic patterns and how do they

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affect the arrangement of the classroom furniture?

3. How do the number of students in a class affect furniture arrangement? (If conditions are crowded, the furniture needs to be arranged more efficiently; some furniture may need to be removed.)
4. Why is there rarely one perfect room design? (Every classroom's needs are different.)
5. Will the winning design always be the best arrangement plan? (Not necessarily. Sometimes what looks good on paper is not practical in reality.)
6. When might you personally use the skill of drawing to scale? (deciding where furniture will go before moving into a place)

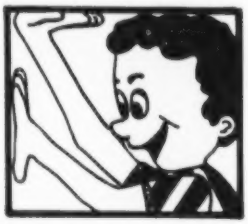
X. Extensions

1. Use the planning sheet to design another room at school (science lab, computer lab, home economics room) or home.
2. Invite an interior decorator to speak on room design and furniture arranging.

XI. Curriculum Coordinates

Language Arts: Write to the nearest college to find out what a person must study to become an interior designer.

Art: Design the ultimate classroom of the future, trying to anticipate needs and futuristic teaching aids.



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Names _____

Room to Move

PLANNING SHEET

Kind of Room: _____

	ACTUAL	SCALE
Length	_____	_____
Width	_____	_____
Area	_____	

SCALE _____ to the _____

Things to consider:

_____ _____

_____ _____

_____ _____

_____ _____

INVENTORY

Item	#	Actual Dimensions	Scale Dimensions	Item	#	Actual Dimensions	Scale Dimensions

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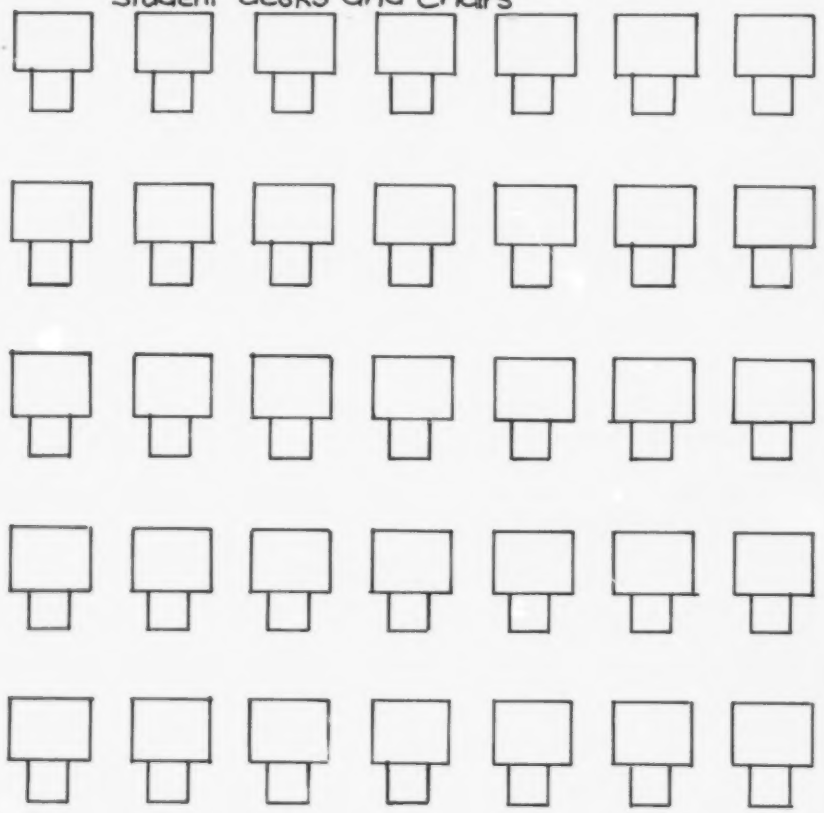
Room to Move

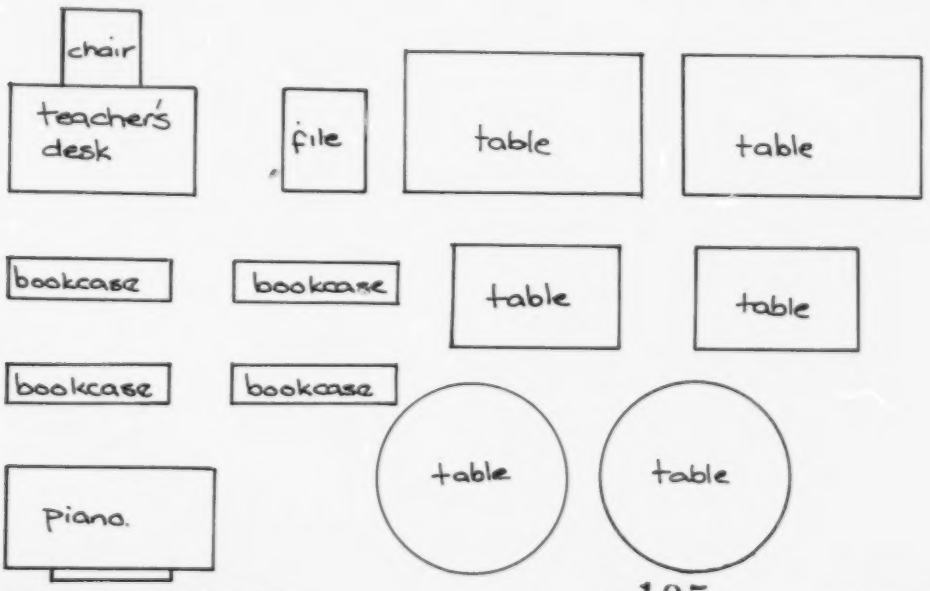
These are some average furniture sizes. Yours may be different. Supplement with your own drawings and cut what is needed.

SCALE 1:50 OR
5 centimeters to
the millimeter

Student desks and chairs



ITEM	ACTUAL cm	SCALE mm
Student desks	45×60	9×12
Student chairs	30×30	6×6
Teacher desk	80×140	16×28
File	60×75	12×15
Large tables	100×175	20×35
Medium tables	75×120	16×24
Teacher chair	60×60	12×12
Round tables	diameter 150	30
Bookcases	30×120	6×24
Piano	75×150	15×30



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SHRINKING BOUNDARIES

I. Topic Area
Scale drawing

II. Introductory Statement
Students will create a scale map of half of a basketball court. Maps will then be paired to complete a full court.

III. Social Science Processes
Making maps
Locating/Organizing data
Working cooperatively
Communicating ideas

Science Processes
Measuring
Collecting/Recording data
Comparing

Math Skills
Estimating
Rounding
Measuring length
Using decimals
Using ratios
Drawing with a compass

IV. Materials
Worksheet
Meter sticks or tapes
Metric rulers
Graph paper, 1/4" or smaller
Drawing compasses

V. Key Question
How do you shrink a basketball court?

VI. Background Information
A regulation basketball court is 94 by 50 feet or approximately 23 by 15 meters. Elementary school courts may vary due to space or other factors.

To determine the scale, develop a ratio between the longest measurement and the graph paper squares. If the longest measurement is 12 meters and the length of the paper is 43 squares, the scale of 1 meter = 3 squares would be a good choice.

VII. Management
1. This activity may take one or two 60-minute periods, depending on student abilities.
2. Groups of four are recommended. An even number of groups are needed for pairing maps.
3. Decide on the standard for rounding. The nearest meter may be easy, but not very accurate for shorter measurements. The nearest decimeter is a good choice.
4. Students should record actual lengths in decimals. For example, a measurement of 13 meters 78 centimeters should be recorded as 13.78 meters. Rounded to the nearest decimeter, it would be 13.8 meters.
5. Although graph paper is suggested, capable students may wish to do the scale drawing on blank paper. The scale would be meters to centimeters or millimeters.
6. Accuracy will be determined by pairing group maps at the end of the activity.
7. If *additional problem solving emphasis* is desired, present the key question but do not use the worksheet. Have the students look at the basketball court, decide which measurements are needed, and design their own table for making a scale drawing.

VIII. Procedure
1. The teacher will:
   a. Ask the key question
   b. Review the parts of a basketball court.
   c. Discuss measuring and drawing to scale.
2. Student groups will:
   a. Go to the court and estimate the total length and width.
   b. Measure and record the actual and rounded lengths in the table.
   c. Calculate the scale needed to recreate the basketball court on the paper provided. The teacher may need to give guidance.
   d. Figure the scale measure or number of squares for each measurement in the last column. To pair maps, all groups must use the same scale.
   e. Complete the scale drawings. A compass is useful for drawing the circles. The midpoint of each line must be found first.
   f. Line up their scale map with another group's map to make a full court.

IX. Discussion
1. What is the value of drawing to scale?
2. What professions use scale drawings? (cartographers, architects, pool designers, interior decorators, furniture designers, landscapers, etc.)
3. Was this court ever drawn to scale? (probably before it was placed on the playground)

X. Extensions
1. Take another playground court or area and draw it to scale.
2. Locate maps which use scale. Make a table such as:

Name of book	Map found	Scale ratio

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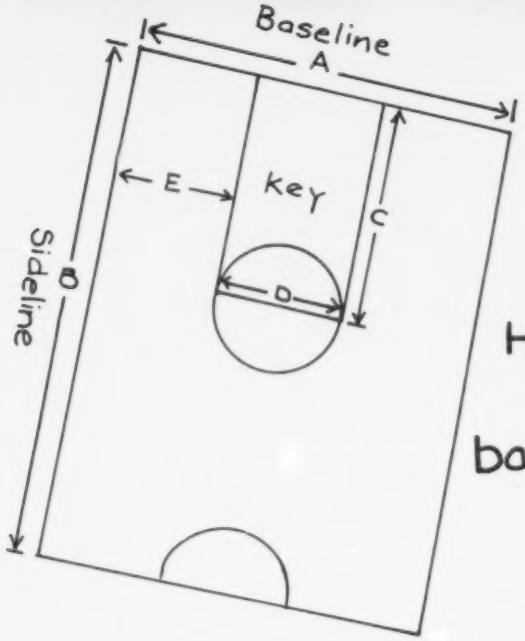
SHRINKING BOUNDARIES



_____
_____
_____
_____
Cartographers

How do you shrink a basketball court?

FULL COURT	
LENGTH	WIDTH

PREDICT _____ _____

ACTUAL _____ _____

SCALE _____ to the _____

		LENGTH		
	LINE	ACTUAL	ROUNDED	SCALE
A	Baseline			
	Baseline/2			
B	Sideline			
C	Baseline to free throw line			
D	Free throw line			
	Free throw line/2			
E	Sideline to key			

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Bird's eye view

I. Topic Area
School design

II. Introductory Statement
Students will create a school site which will meet specific needs.

III. Social Science Processes
Making maps
Communicating ideas
Working cooperatively
Interpreting data
Solving problems

Science Processes
Collecting/Recording data
Interpreting data
Applying
Identifying/Controlling variables

Math Skills
Problem solving
Measuring

IV. Materials
Planning sheet
Fact sheet
Large white or manila construction paper
Crayons or colored pencils
Metric rulers

V. Key Question
If you could plan a new school, how would it look?

VI. Background Information
An architect can draw a school in many ways. Traditional schools have long classroom wings, but new designs have been tried in recent years. These include "open space" rooms and nearly square buildings with classroom clusters. The factors an architect must consider are discussed in the fact sheet, "School Architecture".

If some actual blueprints are brought for the class to examine, students will notice symbols for such things as windows, doors, cabinets and plumbing. Since the focus of this activity is on a general school plan, decide which details are important and which can be eliminated.

This project can be used to redesign the school the students attend or to create a school for a different setting and needs.

VII. Management
1. This project will take an initial period of 45-60 minutes, followed by several 40-minute periods. The time spent depends upon the guidance of the teacher and how well the students understand the intention of the project.
2. The chart with brainstorming ideas should be in sight during the entire project.
3. Emphasize that the design should be a floor plan, not a side-view drawing.
4. Students may create individual designs or work in pairs.

VIII. Procedure
Introductory Activities
1. Begin with a tour of the school plant.
2. In small groups, students will brainstorm the things to be considered when designing a school. Write group ideas on a chart or butcher paper as they are shared with the total class.
3. Students will study the brainstorming chart and fact sheet, decide which factors are most important, and complete the top part of the planning sheet.

Designing Time
4. Agree on symbols for doors, windows, etc. Study an actual floor plan if possible.
5. Students will work on their school designs.

Concluding Activities
6. Students will write a paragraph describing for whom their school was made and attach it to their designs.
7. Display finished designs or allow time for oral presentations.

IX. Discussion
1. How does your school fit the needs for which it was designed?
2. Does this school use space economically or wasn't this important?
3. What costs must be considered when building a school? (land, construction material, crew, finish work like painting, landscaping, etc.)
4. How expensive do you think your school would be to build?
5. When was our school built? How expensive do you think it was to build this school? (Check with the district business manager to obtain the data for this and other schools in your district.)

X. Extension
Compare school styles in your town. Are pictures available?

XI. Curriculum Coordinates
Math
1. Make a bar graph comparing the building costs of different schools in your district. Include the years they were built.
2. Using a scale ratio, find the approximate floor area to determine how much floor tile or carpeting will be needed. Obtain the current price from a local store and compute the cost.

Art
1. Draw a side-view of the school complete with school name.

Books
1. *How a House Happens* by Jan Adkins (1983, paperback)

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Bird's eye view

Architects

What must you consider when designing a school?

FACTOR	OUR SCHOOL
number of students	

Complete the following paragraph and attach it to your architectural plan.

This school was designed for _____

_____

_____

_____

_____

_____

_____

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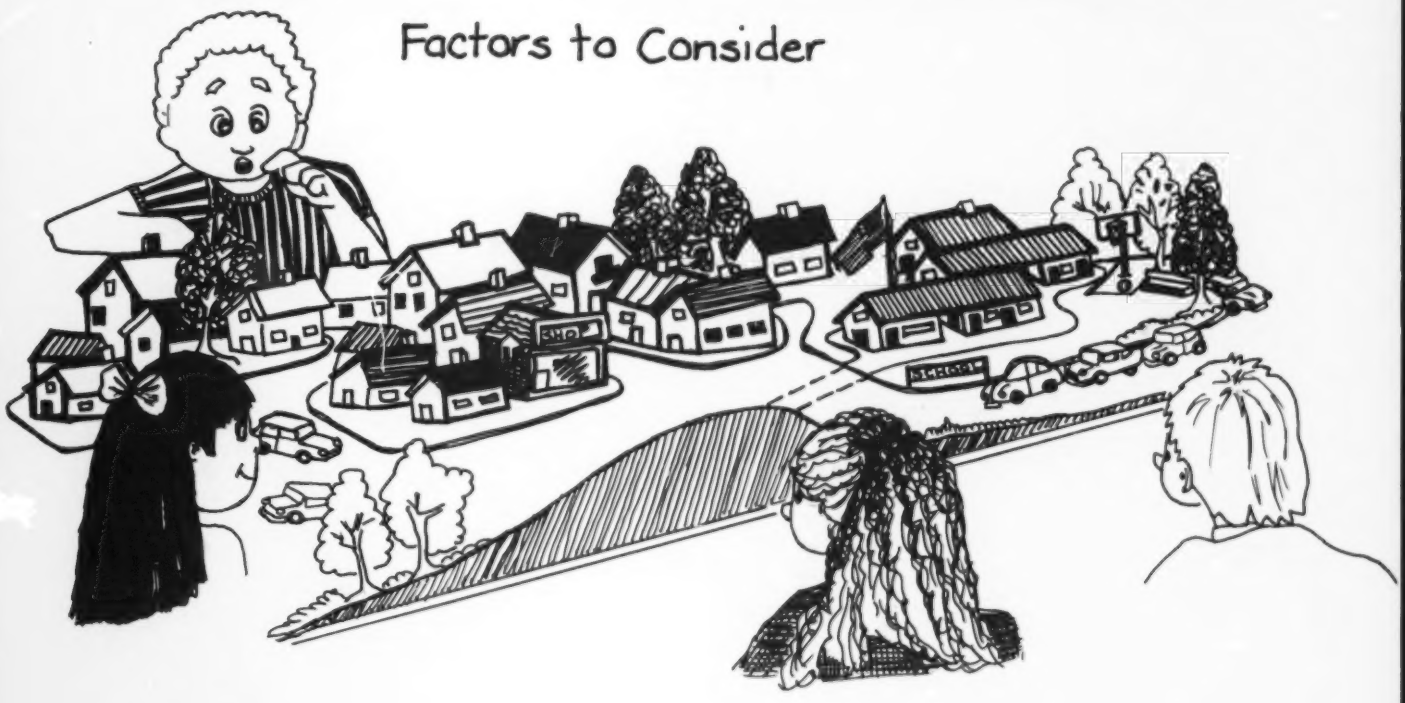
School Architecture

Factors to Consider



1. NEIGHBORHOOD

   a. **Urban**: high population density, industries and business, culturally rich environment, many apartment dwellers, multicultural, scarce land Conclusion- The school needs to conserve space.

   b. **Suburban**: mostly single family homes, little business or industry, commuter population, less ethnic diversity, highly mobile residents

   c. **Rural**: farming or ranching families, permanent and seasonal workers, single family homes, spread out Conclusion -One school serves a large area.

2. ARCHITECTURE

   What is the style of the buildings in the surrounding area?

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3. PHYSICAL CHARACTERISTICS

a. Room size - What is the proposed class size?
b. Purpose of the room - multi (auditorium, cafeteria) or single use
c. Placement of windows, number and position of electrical outlets
d. Sound - Is there an airport, train station, or large business nearby?
e. Climate

4. LANDSCAPE

What will be planted on the grounds? Where?

5. PLAYGROUND

What play areas and equipment are needed? Where?

6. SAFETY

a. Access for the handicapped
b. Location of streets, roads and highways
c. Businesses and/or buildings nearby

7. STUDENT BODY

a. Students with special needs such as the handicapped
b. Special grading system (K-2, 3-6, K-8, etc.)
c. All-boy or all-girl

8. SPECIAL SERVICES

What kind of space is needed for counselors, the nurse, the secretary, administrators, the music teacher, the p.e. teacher, and others?

The final consideration concerns not only the architect but also those who attend. A school is a place for students to formulate ideas and use the information given. A school should be a place which is functional and pleasing to attend?

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Shop 'Til You Drop

I. Topic Area
Making a scale model from a plan

II. Introductory Statement
Students will create a floor plan of a shopping mall and convert it to a three-dimensional model. Alternatives include creating a town, harbor, farm, or a scene from a magazine.

III. Social Science Processes
Making/Reading maps
Locating/Organizing data
Interpreting data
Working cooperatively
Communicating ideas

Science Processes
Measuring/Comparing
Collecting/Recording data
Interpreting data
Applying

Math Skills
Measuring
Computing scale ratio

IV. Materials
Colored construction paper
Base such as cardboard or plywood for each model
Graph paper, size is optional
Crayons or colored pencils
Tape and glue
Calculators, optional

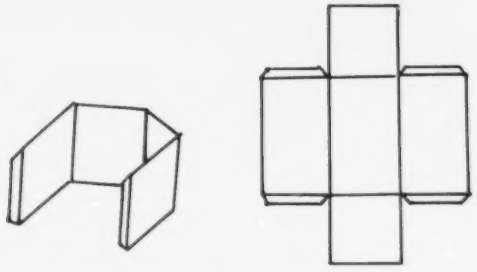
V. Key Question
How will your mall compare to others in your class?

VI. Background Information
Architects often make scale models when presenting their projects to potential buyers. Sometimes models are used during a court trial. When transforming a map to a model, scale becomes a subject of concern. If students are given opportunities to experience the physical transfer, the process becomes more personalized.

The scale format used by The National Geographic Society includes a ratio followed by the relationship to a unit of measure.

Example: 1:50 or 5 centimeters to the millimeter

VII. Management
1. Groups of 2-4 are suggested.
2. This activity will take several 45 minute periods.
3. When the class is ready to construct their models, show them how to make rectangular buildings from construction paper. Ignore the tabs if tape is used instead of glue.



Without roof With roof

4. Model size will be determined by space and available base materials.

VIII. Procedure
Student groups will:
1. Brainstorm types and sizes of buildings they may find in a mall.
2. Design a mall (town or harbor) on graph or plain paper. It is helpful to start with a rough sketch.
3. Measure each store or structure on the drawing and record the dimensions on the table.
4. Measure their base and decide on a scale ratio. Record and draw a line scale on the worksheet.
5. Convert the map dimensions to model dimensions and record.
6. Construct the model using construction paper and other materials.
7. Give an oral presentation about their design.

IX. Discussion
1. How do the malls differ from each other? How are they the same? How do they compare to those in your area?
2. How did you decide what stores to put in your mall? (ideas from malls visited, stores that appeal to you, etc.)
3. Is your mall specialized? (built for the community, a certain age group, etc.)
4. How difficult was it to make a three-dimensional model from a two-dimensional drawing?

X. Extensions
1. Create a "rug town" or "rug farm" to be used by the kindergarten. Using pieces of fabric, enlarge a two-dimensional version of the plan on rug scraps sewn together. This creates a play area for use with toy cars, boats, or animals.
2. Use a grid system for reproducing a picture. Draw grid lines on the picture. Then reproduce the image within each square onto a larger piece of paper.

XI. Curriculum Coordinate
Art: Landscape the model.

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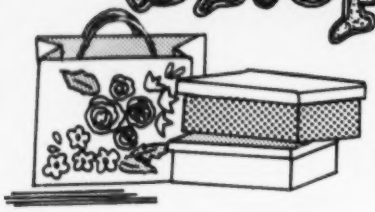
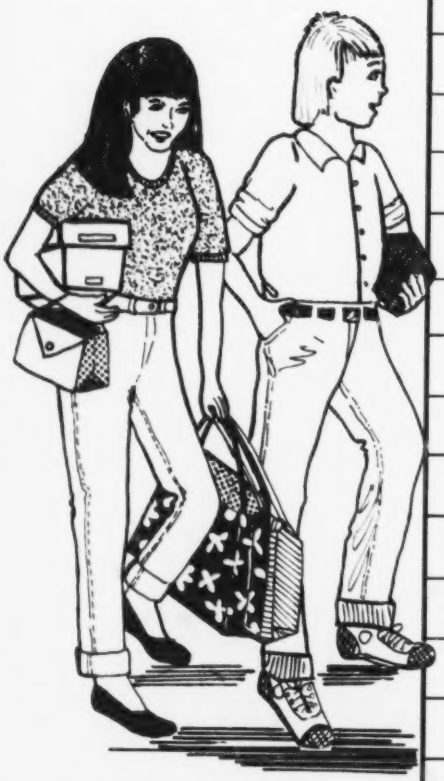
Shop 'Til You Drop



_____
_____
_____
_____
Architects

We have chosen to design and build a _____.

Scale ___:___ or _____ to the _____



STORE/STRUCTURE	DRAWING DIMENSIONS	SCALE MODEL DIMENSIONS

Continue the table on the back if needed.

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Navigating Numerically

I. Topic Area
U.S. road sign patterns

II. Introductory Statement
Students will discover the system used for numbering Interstate highways.

III. Social Science Processes
Reading maps
Locating/Organizing data
Interpreting data
Drawing conclusions
Working cooperatively
Communicating ideas

Science Processes
Collecting/Recording data
Interpreting data
Applying/Generalizing
Comparing

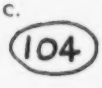
Math Skills
Problem solving
Finding patterns
Logical thinking

IV. Materials
Worksheets: chart, U.S. map, state abbreviations
U.S. road maps, one per group
Fact sheets

V. Key Question
You parachute from an airplane somewhere in the United States. You scramble out from under your silken canopy. The first thing you see is an Interstate road sign. Where in the United States are you?

VI. Background Information
1. There are three major types of roadways criss-crossing the United States:
   a.

   Interstate highways which cross through more than one state.
   b.

   U.S. highways (federal) which often connect Interstates and can pass through more than one state.
   c. 

   State highways which are maintained inside state borders. If the road continues into another state, it receives another designation.
   d. Some north/south roads may, for short distances, veer off in an east/west direction. The same is true of some east/west roads, which may veer off in a north/south direction.
2. Interstates with three numbers (I-495) are radial, loop, or spur alternate routes. The last two digits (I-95) represent the number of the main route. These 3-digit Interstates often skirt around or encircle large metropolitan areas.
3. Business loops or spurs are one or two digit numbers on green signs. These indicate a convenient route through the business section of a city.

4. Refer to the two fact sheets concerning Interstates and U.S. highways for a more graphic explanation of signs, directions, and general locations.

VII. Management
1. Do not show students the fact sheets until after they have explored the maps and discovered the pattern to the Interstate number system.
2. Time: one 45 minute period.
3. Students may work in groups of 3-5, depending on available maps.

VIII. Procedure
1. Teacher should read aloud the parachute scenario. Discuss the information an Interstate road sign would give.
2. Pass out worksheet. Reread the "scenario" together and state the problem. Optional: Students can devise their own table to find the patterns.
3. Pass out road maps—one per group. Students will study the road map and fill in the chart. The post office abbreviations fact sheet is provided as a reference. To make the patterns more recognizable, they will also draw their own road map of the Interstate highways listed on the outline map.
4. After completing the chart and map, students will discuss the results and write about the patterns they have discovered.

IX. Discussion
1. Can you tell *exactly* where you are by looking at an Interstate sign? (No.)
2. Can you tell *approximately* where you are? (Yes, if you know the pattern. You are in the eastern fourth of the country around the states of Georgia, Tennessee, Kentucky, and Ohio.)
3. What information does an Interstate road sign give you? (just a number)
4. What other kinds of signs, along with the Interstate sign, might help you know exactly where you are? (a junction sign with another highway, road mileage signs to various cities, etc.)
5. What else, besides signs, could give you location clues? (vegetation, climate)
6. What kind of numbers run east/west? (even) North/south? (odd)

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7. Where are smaller numbers found? (in the South and West) Larger numbers? (in the North and East)
8. Find some three-digit roads on the map. Where do you usually find signs with three digits? (around large metropolitan areas) What do you think three-digits indicate? (an Interstate that bypasses a city or is an alternate route)
9. What other types of roads are shown on your road map? What symbols are used?

X. Extensions

1. Discover the pattern for numbering U.S. or Federal highways. (See fact sheet.)
2. Study other symbols shown in the road map key.
3. Make a large class map showing major Interstates.

XI. Curriculum Coordinates

Math

1. Using the scale, determine the approximate length of major Interstates in kilometers or miles. Make a comparison graph.
2. Determine the time needed to travel the full length of the U.S. following a 55 mph speed limit.

Science

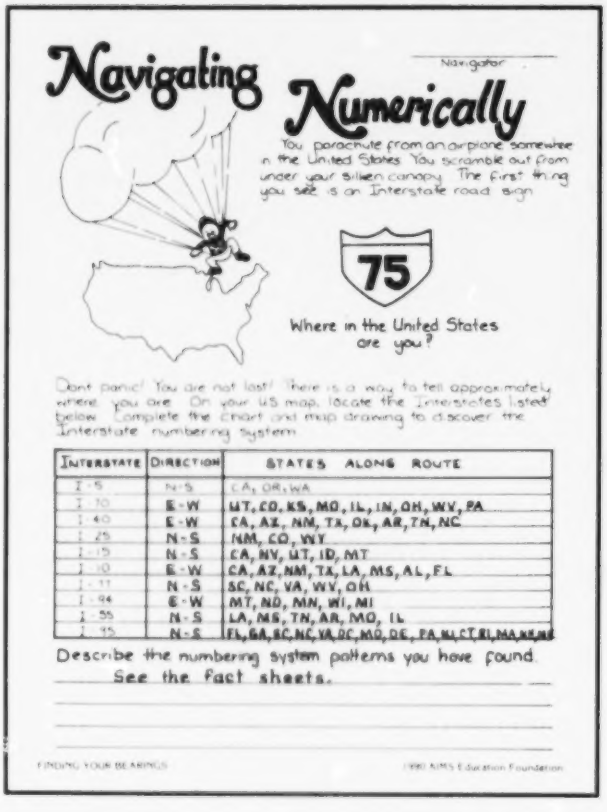
1. Determine land forms and vegetation along major Interstates.

Language Arts

1. Discuss the variety of terms used to name roads: highway, interstate, freeway, parkway, turnpike, toll road.

Economics

1. Have students search some ways money is raised for road repair and upkeep. (Taxes, tolls, trucker's fees, etc.)



Navigator

Navigating Numerically

You parachute from an airplane somewhere in the United States. You scramble out from under your silken canopy. The first thing you see is an Interstate road sign.

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Where in the United States are you?

Don't panic! You are not lost! There is a way to tell approximately where you are. On your US map, locate the Interstates listed below. Complete the chart and map drawing to discover the Interstate numbering system.

Interstate	Direction	States along route
I-5	N-S	CA, OR, WA
I-10	E-W	UT, CO, KS, MO, IL, IN, OH, WV, PA
I-40	E-W	CA, AZ, NM, TX, OK, AR, TN, NC
I-25	N-S	NM, CO, WY
I-15	N-S	CA, NV, UT, ID, MT
I-10	E-W	CA, AZ, NM, TX, LA, MS, AL, FL
I-77	N-S	SC, NC, VA, WV, OH
I-94	E-W	MT, ND, MN, WI, MI
I-55	N-S	LA, MS, TN, AR, MO, IL
I-95	N-S	FL, GA, SC, NC, VA, DC, MD, DE, PA, NJ, CT, RI, MA, NH, ME

Describe the numbering system patterns you have found.
See the Fact sheets.

FINDING YOUR BEARINGS

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Navigating Numerically

Navigator

You parachute from an airplane somewhere in the United States. You scramble out from under your silken canopy. The first thing you see is an Interstate road sign.

Where in the United States are you?

Don't panic! You are not lost! There is a way to tell approximately where you are. On your U.S. map, locate the Interstates listed below. Complete the chart and map drawing to discover the Interstate numbering system.

INTERSTATE	DIRECTION	STATES ALONG ROUTE
I-5	N-S	CA, OR, WA
I-70		
I-40		
I-25		
I-15		
I-10		
I-77		
I-94		
I-55		
I-95		

Describe the numbering system patterns you have found.

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Navigating Numerically

Navigator

CT MI MN MS MO MT NE NV NH NJ NM NY NC ND OH

AL AK AZ AR CA CO DE FL GA HI

ID IL IN IA KS KY LA ME MD MA

Draw and label the highways on the chart.

OK OR PA RI SC SD TN TX UT VT VA WA WV WI WY

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Navigating Numerically

OFFICIAL POST OFFICE STATE ABBREVIATIONS

AL	Alabama	MT	Montana
AK	Alaska	NE	Nebraska
AZ	Arizona	NV	Nevada
AR	Arkansas	NH	New Hampshire
CA	California	NJ	New Jersey
CO	Colorado	NM	New Mexico
CT	Connecticut	NY	New York
DE	Delaware	NC	North Carolina
FL	Florida	ND	North Dakota
GA	Georgia	OH	Ohio
HI	Hawaii	OK	Oklahoma
ID	Idaho	OR	Oregon
IL	Illinois	PA	Pennsylvania
IN	Indiana	RI	Rhode Island
IA	Iowa	SC	South Carolina
KS	Kansas	SD	South Dakota
KY	Kentucky	TN	Tennessee
LA	Louisiana	TX	Texas
ME	Maine	UT	Utah
MD	Maryland	VT	Vermont
MA	Massachusetts	VA	Virginia
MI	Michigan	WA	Washington
MN	Minnesota	WV	West Virginia
MS	Mississippi	WI	Wisconsin
MO	Missouri	WY	Wyoming

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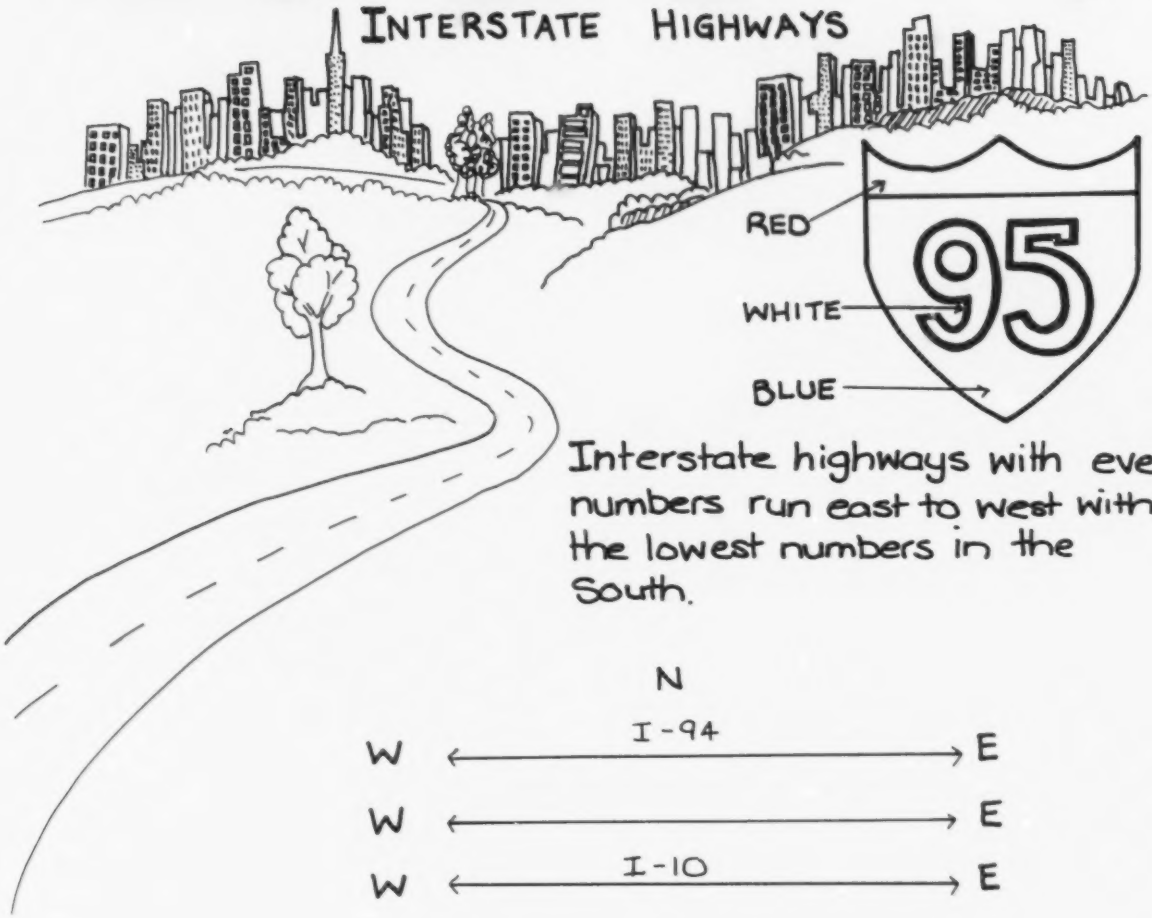
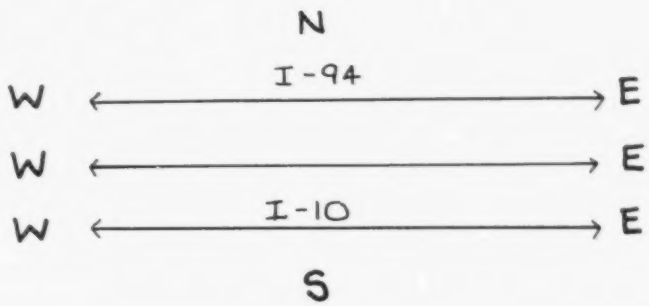
Navigating Numerically

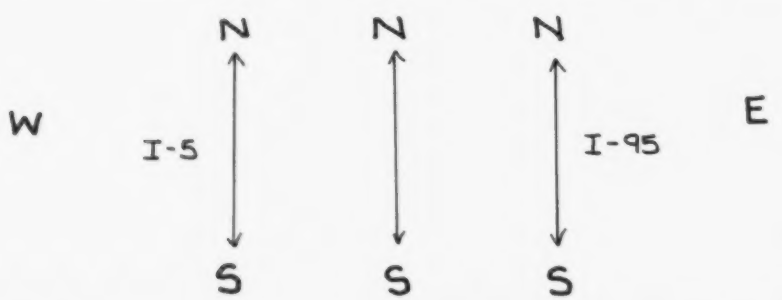
INTERSTATE HIGHWAYS



Interstate highways with even numbers run east to west with the lowest numbers in the South.



Interstate highways with odd numbers run north and south with the lowest numbers in the West.



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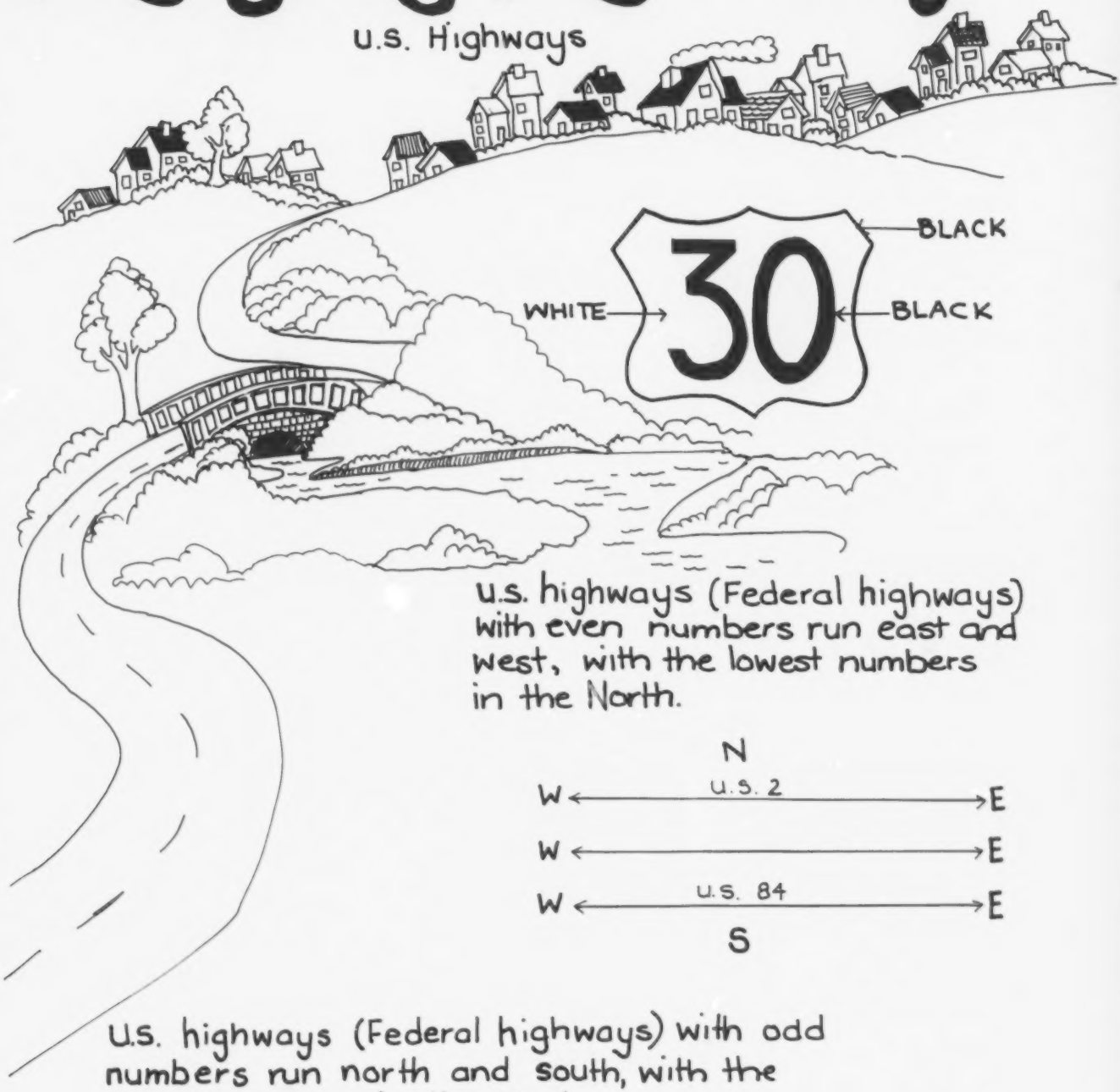
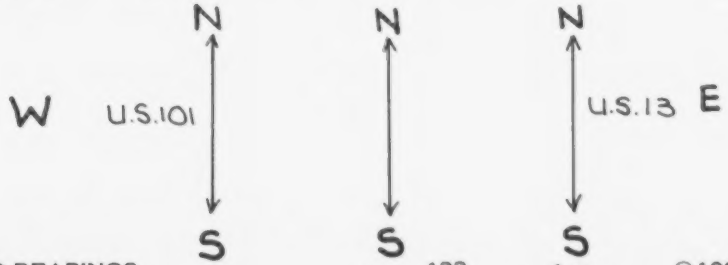
Navigating Numerically

U.S. Highways



U.S. highways (Federal highways) with even numbers run east and west, with the lowest numbers in the North.

U.S. highways (Federal highways) with odd numbers run north and south, with the lowest numbers in the East.



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Rallying Around

I. Topic Area
U.S. road map

II. Introductory Statement
Students will use a U.S. road map to measure and compare distances between certain randomly selected cities, simulating a road rally.

III. Social Science Processes
Reading maps
Working cooperatively
Communicating ideas
Locating/Organizing data
Drawing Conclusions
Solving Problems

Math Skills
Measuring
Estimating
Rounding
Computing
Using a calculator
Using formulas
Computing scale ratio

Science Processes
Measuring/Comparing
Collecting/Recording data
Predicting

IV. Materials
Kite string, 2 m per group
Crayons or markers
Rulers
Calculators
U.S. road map, one per group
Worksheets
Driving distance charts or transparency of chart

V. Key Question
You have been chosen to participate in a "See America Road Rally". You will be allowed to pick five cities at random to visit. After choosing your five cities, how long do you think your trip will take?

VI. Background Information
While this investigation is set up to resemble a road rally to spark student interest, the major objectives include reading a road map, identifying the most direct route between two places, and using a scale of miles. Students are also asked to locate and label selected cities and to identify states.

During the rally students must follow a speed limit of 55 mph, but reality dictates that road conditions, traffic, weather, and other factors might affect travel speed. The 55 mph limit is used as a constant average to facilitate the universality of this lesson. Miles, rather than kilometers, are used in this lesson because of the availability of mileage information. Most road maps have kilometer scales which can be used, if you wish, along with a metric speed limit. The driving distance chart included would not be applicable.

You and your students must decide the number of hours which may be driven each day. Since this is a "See America Road Rally", a certain amount of scenic observation would likely take place. Five hours or ten hours of driving would facilitate the mathematics for lower grade students. Numbers such as six or eight hours would make the mathematics slightly more involved. The choice of the number of driving hours is yours. The easiest way to convert the map's scale distance to actual distance is to figure out the number of miles per centimeter. If an accurate estimate is made, this figure can be multiplied by the measured string length to obtain the actual distance. An alternative would be to construct a longer version of the map's scale distance and lay the string along it.

VII. Management
1. Students should work in groups of 4-5.
2. The lesson will take approximately 60 minutes.
3. To prepare the string, put tape around one end to mark the beginning of the group's measurements. As students reach each city, they will make a mark on the string. Their string measurements will be approximate.
4. Students should be reminded to return to the city of origin, thus completing the rally.

VIII. Procedure
Student groups will:
1. Cut out the city cards, lay them face down, and mix them up. Five cards will be drawn, indicating the cities on their road rally route.
2. Locate the cities on a U.S. road map, record them on the blank map, and list them (along with their states) in column one of the table.
3. Complete the second column, matching the numbers in column one.
4. Decide, as a class, the number of driving hours allowed per day and calculate the maximum number of miles allowed per day. Record. Students must stop driving for the day when they reach one of their five cities even if they haven't driven the limit.
5. Make a prediction about the length of their trip.
6. Carefully estimate and record the number of miles equivalent to one centimeter, according to the map scale.
7. Place the string along the roads to measure the distance between each city to the nearest tenth of a centimeter. Record as a decimal.
8. Figure the actual distance by multiplying string length times number of miles in one centimeter. Other methods may also be used.
9. Draw straight lines between cities on the blank

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map to show the route. Write the actual distances on the lines.

10. Figure hours by using the time formula on the worksheet, recording as a decimal rounded to the nearest tenth.
11. Figure number of days used according to the rules.
12. Compute all totals. If there is a tie between two or more groups for the least number of days, look at the hour totals.
13. Compare distances and times with the "Driving Distances Chart" provided.

IX. Discussion

1. How long did your rally take?
2. What was the shortest leg of your trip?
3. What was the longest leg?
4. How did you decide the order in which to visit your five cities?
5. What kinds of problems did you have deciding the most direct route? How did you resolve these problems?
6. Through how many states did your rally take you? What are they?
7. What different regions did you visit?
8. Compare distance estimates between groups with some of the same cities.

X. Extensions

1. Rework the lesson using "as the crow flies" distance.
2. Get an airline schedule. Compare driving time to flight time. Should you include the wait at the airport?
3. Figure out the longitude and latitude of each city. Compare climate.
4. Rank cities by population.
5. Pin one road map to a bulletin board. Using different color yarn trace each group's trip. Pin paper markers showing the order. Paper cars can be placed at the city of origin.
6. Determine which two cities are farthest apart.
7. List major highways traveled.
8. Make a graph which will compare the groups' distances and times.
9. Discuss adjustments that need to be made when traveling through time zones.

XI. Curriculum Coordinates

Art

1. Draw road signs that might have been seen along the way.
2. Draw billboards.
3. Design a poster advertising the "See America Road Rally".

Computers

1. "Survival Math" (Travel Agent) from Sunburst Communications, Inc.

Games

1. "Scotland Yard" from Milton Bradley
2. "Vacation" from Rand McNally

Science

1. Use the U.S. weather map in local newspapers to graph temperatures of cities visited. See the activity, *The Forecast for Today*.

Language Arts

1. Write out directions for someone who would like to follow your route.
2. Research cities visited to learn about founding date, points of interest, etc. Design a travel brochure.

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Rallying Around

TEAM _____

1. Cut out city cards, lay face down, and draw five. Label these five on the map.
2. Show your route by drawing straight lines between the cities. As you travel, write the actual distances on the lines.

Albuquerque	Denver	New York City
Atlanta	Detroit	St. Louis
Boston	Los Angeles	Salt Lake City
Chicago	Miami	San Francisco
Cleveland	Minneapolis	Seattle
Dallas	New Orleans	Washington, D. C.

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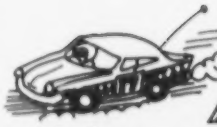

Rallying Around

Driver _____

1. In the first column, list the five cities on your itinerary. The first should be closest to your hometown. List other cities in the most logical order. Remember, you must return to the first city.
2. Complete the second column, matching the numbers in the first column.
3. You may drive ____ hours per day. The speed limit is 55 mph. The maximum number of miles per day will be _____. You must stop driving for the day if you reach a city.

How many days do you think your road rally will take? ☐

4. You are now ready to start your "See America Road Rally." Use string and scale of miles to measure distances. Travel the most direct route.

MAP SCALE: _____ miles to the centimeter

CITIES, STATES			DISTANCE		TIME	
FROM	TO	ROADS TRAVELED	STRING	ACTUAL	HOURS (to 10th)	DAYS
1.	2.					
2.	3.					
3.	4.					
4.	5.					
5.	1.					
		TOTAL				

$$\text{Time} = \frac{\text{Distance}}{\text{Rate}}$$

How many days did your road rally actually take? ☐

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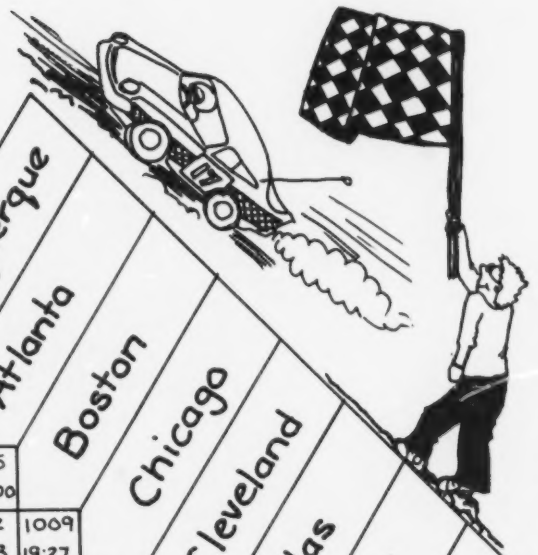
Rallying Around

Driving Distances Chart



518 = Distance in miles
10:14 = Driving Time

These distances and driving times represent the most favorable commonly traveled routes under normal conditions.

Driving Times are average times within posted speed limits, excluding stops.

Albuquerque	Atlanta	Boston	Chicago	Cleveland	Dallas	Denver	Detroit	Los Angeles	Miami	Minneapolis	New Orleans	New York City	St. Louis	Salt Lake City	San Francisco	Seattle	Washington, D.C.
1424 28:31																	
2248 43:56	1115 22:00																
1351 26:44	722 14:03	1009 19:27															
1616 31:27	734 14:32	654 12:31	355 6:56														
670 13:11	815 16:11	1795 35:28	933 18:58	1198 23:41													
449 8:46	1442 28:06	2016 38:57	1047 20:12	1362 26:26	806 16:05												
1572 31:08	735 14:43	832 16:10	287 5:34	178 3:39	1154 23:22	1334 25:46											
920 15:51	2244 44:22	3082 60:07	2113 41:22	2428 47:36	1425 27:56	1066 27:10	2400 46:56										
2018 39:00	688 12:49	1571 31:12	1410 26:52	1342 27:04	1348 25:49	2130 40:55	1423 27:32	2773 53:45									
1257 24:47	1152 22:15	1439 27:39	430 8:12	785 15:08	1013 19:49	941 18:00	717 13:46	2007 39:10	1840 35:04								
1188 23:25	488 9:44	1578 31:05	983 19:20	1092 21:15	518 10:14	1324 26:19	1093 21:26	1906 37:42	900 16:54	1223 25:02							
2029 39:31	996 17:35	219 4:25	831 16:17	476 9:21	1576 31:03	1822 35:29	654 13:00	2849 55:22	1352 26:47	1261 24:29	1359 26:40						
1051 20:26	598 11:42	1197 23:30	300 6:18	565 11:01	633 12:40	844 16:24	521 10:42	1871 37:11	1286 24:31	540 12:00	683 13:02	978 19:05					
617 12:00	1949 38:45	2420 46:22	1451 27:37	1766 33:51	1287 25:11	507 10:39	1788 33:11	721 14:00	2687 51:34	1267 25:30	1805 35:25	2242 43:12	1351 27:03				
1109 21:38	2533 50:09	3174 61:20	2205 42:35	2520 48:49	1779 34:49	1261 25:37	2492 48:09	425 8:29	3127 60:38	2021 40:29	2297 45:03	2996 58:10	2105 42:01	754 14:58			
1460 29:30	2793 53:04	3123 59:27	2114 40:00	2469 46:56	2136 42:41	1350 28:09	2401 45:34	1174 22:51	3481 65:53	1684 31:48	2648 52:55	2945 56:17	2195 41:22	843 17:30	852 16:15		
1896 37:68	672 12:47	443 9:13	753 15:29	398 8:33	1352 26:15	1689 33:09	576 12:12	2716 52:59	1128 21:59	1183 23:41	1160 22:31	224 4:48	845 16:42	2168 41:50	2922 56:48	2867 55:29	

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What a Relief!

I. Topic Area
Relief maps

II. Introductory Statement
Students will construct a flour and salt relief map of an area you have studied such as a state, country, or continent.

III. Social Science Processes
Making maps
Locating/Organizing data
Working cooperatively
Communicating ideas

Science Processes
Observing
Measuring
Collecting/Recording data

Math Skills
Measuring

IV. Materials

PER STUDENT:
250 ml (1 c.) flour
125 ml (1/2 c.) salt
125 ml (1/2 c.) water
8½ × 11" cardboard or larger
Outline map fitting cardboard
Bowl or large plastic milk container, cut down
Tongue depressor, optional
Toothpicks
Gummed labels or several 5 cm strips of masking tape

PER TABLE:
Recipe
Glue and tape
Measuring cups and spoons
Butcher paper

PER CLASS:
Sample relief maps
Physical map of area duplicating

V. Key Question
How can you turn flour, salt and water into a map?

VI. Background Information
The relief map should be a culminating activity after thoroughly studying an area. Students should already be familiar with the major land masses of the area you are mapping.

VII. Management
1. This lesson will take three or more sessions.
2. There are three stages to the lesson: the forming stage, painting stage, and the labeling stage.
3. *With parental/adult help:* Arrange for parent volunteers to work as group leaders, one for every six students. Assign students to groups. Students bring a mixing container and two baggies, one filled with 250 ml flour and the other filled with 125 ml salt, from home. All groups work at the same time.
4. *Without parental/adult help:* Organize class into groups. Obtain salt and flour ahead of time, 10 pounds of each per class of 30. One or two groups measure and mix dough while others complete assignments. When finished mixing, they take the dough to their desk and begin the map. New groups start mixing. Repeat until everyone is done. Circulate between those mixing and those working on the maps.
5. Plan a "free time menu" or additional activity that students will do when they are finished with their maps.
6. Try to arrange to do the maps in another room, preferably one with tables (i.e., cafeteria). Cover all tables with butcher paper to ease clean-up.
7. Students may work on an individual map or may do a group map.
8. Put a copy of directions to "What a Relief!" in a transparent envelope or ziploc baggie. Place one copy on each table.
9. Set up an area where the maps can dry.

THE KEY to a successful relief map making lesson is to be well organized and have everything set up in advance.

VIII. Procedure
1. On the day before the lesson, send home the Relief Note.
2. Assemble all materials and prepare work area (see Management).
3. Assign students to their group leader.
4. Gather in the work area. Review student behavior expectations and what students are to do when their maps are completed.
5. The students will:

Forming Stage
a. Glue their maps onto the cardboard bases.
b. Mix the flour and salt in their bowls with tongue depressors or their fingers. Add water to the mixture to form the dough.
c. Put the dough on their map and form the major physical features of the region. Place toothpicks in the places to be labeled.
d. Clean up their areas.
e. Put their maps in the drying area.

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Painting Stage

a. Paint their maps using an elevation color key.
b. Clean up their areas.
c. Put maps in the drying areas.

Labeling Stage

a. Label the major physical features of their maps, major cities, and major landmarks. Write on the gummed label or 5 cm strip of masking tape and fold it in half around the toothpick.

IX. Discussion

1. Why do we need maps?
2. How is a relief map different from a flat map? (It's 3-dimensional; you can see elevations.)
3. How does a relief map help us to understand more about an area?
4. Why do most map makers use the same colors for elevation? (for standardization)

X. Extensions

1. Mix their own colors using only the primary colors. Match the standard map legend elevation colors.
2. Discuss the benefits of maps vs. oral directions after completing one or both of the following activities.
   a. Have students follow directions to a place on the playground. Then have them follow a map to a location.
   b. Play telephone by giving oral directions to a student, who then gives the directions to the next student and so on to the last student. The last student repeats the directions to the class. Compare the original directions with the final version.

XI. Curriculum Coordinates

Career Education: Research how maps are made.

Art: Have students make relief maps of their faces. Paint the maps to match standard elevation colors.

Language Arts: Create a country from the face maps. Write a fictional report about their country. Include imports, exports, favorite pastimes, flag, major features, places of interest, etc.

Social Science: Compare old and new maps of the same area. The political boundaries and names may change, but the geography will likely remain the same.

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Relief Note!

Dear Parent,

We have been studying _____ in history. Our final activity of the unit will be the making of relief maps. Please have your child measure 250ml (1cup) flour and 125ml (½ cup) salt into two separate plastic baggies. Make sure each baggie is sealed and send to school on _____. Thank you for your support.

Sincerely,

_____

Recipe

METRIC	STANDARD
250ml flour	1 cup flour
125ml salt	½ cup salt
125ml water, approximately	½ cup water, approximately

1. With your hands or a tongue depressor, mix the flour and salt in your bowl. Add a little of the water at a time until the mixture resembles play dough. You may not use all the water. DO NOT MAKE THE MIXTURE RUNNY!
2. Place the dough on your map which has been glued to cardboard and form your relief map. Use the maps in the room to guide you in placing the major physical features. Press toothpicks into each area you are going to label.
3. Put your map in the drying area. It will dry in about one week.
4. Clean up.

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Mystery Mountain

I. Topic Area
Contour mapping

II. Introductory Statement
Students will draw cross sections of contour maps, double the size of the map, and construct a salt/flour 3-dimensional replica. They will match the contour maps with the mountains.

III. Social Science Processes
Making/Reading maps
Interpreting data
Drawing conclusions
Working cooperatively
Communicating ideas

Science Processes
Observing
Measuring/Comparing
Interpreting data
Applying

Math Skills
Measuring
Drawing to scale
Patterning

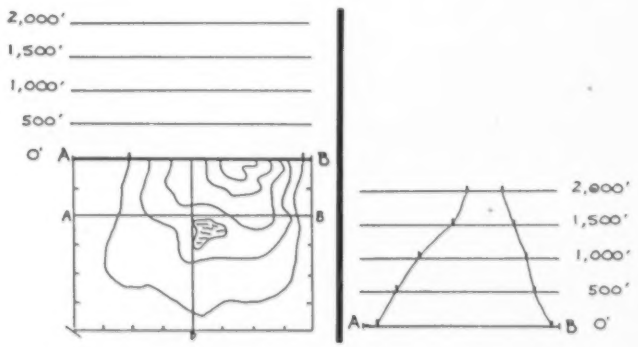
IV. Materials
Worksheets (2 copies of Map A/B needed per group)
Metric rulers
125 ml water per map (1/2 cup)
125 ml salt per map (1/2 cup)
250 ml flour per map (1 cup)
Dinner knives for cutting dough
Rolling pin
Flat surface to roll out dough
Straight pins
16 cm x 16 cm cardboard for each map
Mixing containers such as large milk cartons, cut down

V. Key Questions
If you were on a backpacking trip, how could you actually "see" how high you're going to climb?
What is the mystery mountain that matches this map?

VI. Background Information
Contour, or topographic, maps are used to show varying elevations. The National Forest Service, National Park Service, city planners, landscapers, land developers, and hikers use them. Large area maps are generally now drawn using aerial photography and ground checking. Originally geographers mapped most of the U.S. using transits (surveyor's instruments for measuring horizontal angles) and levels. The process took much time. Most benchmarks and section markers were placed by these men. Many mountains and other geographical points were named by and for these men.

A mountain is a part of the land that rises at least 610 m (2,000 ft.) above the surrounding area. One fifth of the continents are covered by mountains. There are many in Asia, but few in Africa and Australia.

Follow this process to draw the cross sections. Find the line labeled AB on Map A. If it goes through the highest level of the mountain, use this line to mark each elevation as shown below. If it does not cross the highest elevation, use a parallel grid line that does. It is helpful to fold along the chosen line. On the bottom line of the cross section, mark the outermost contours. Then move the map up to the 500 foot line and mark the next contour. When all the marks have been made, connect them with lines. Complete CD, EF, and GH in the same way.



Mark each contour along the line indicated or one parallel to it (left); then connect the marks (right).

While it is the policy of AIMS to utilize the metric system, it seemed appropriate to include an investigation which uses measurement in feet since this is the current common reference used for mountain heights.

VII. Management
1. Familiarize yourself with the procedure for marking cross sections. See Background Information.
2. Day 1: Pass out the various maps, one to each group. Draw Map A cross sections and enlarge on Map B. Groups of 2-3 work well.
   Day 2: Prepare salt and flour mixture. Make salt/flour maps. If there is not much space or equipment for working with the dough, consider having part of the class build their maps each day until all are done.
   Day 3: After a drying period of three or more days, depending upon the weather, paint maps.
3. The recipe for the salt/flour mixture is: 2 parts

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flour, 1 part salt, and 1 part water. Add water until dough is stiff enough to form a ball, but not sticky. It is likely all of the water will not be needed.

4. Cover flat tables with butcher paper and sprinkle with flour. Roll out dough to a thickness of about 1/2 cm or 1/4th inch.
5. Lay Map B over dough and punch pin holes along outer contour line to mark the cutting line. Lift off map and cut dough with a dinner knife. Place on the cardboard, matching cross section letters and grid lines.
6. Stack each section on top of the other. Repeat for each layer. Smooth out the square edges to make a realistic map.
7. For the culminating activity, pick one contour map each day and have students find the mystery mountain(s) that matches it. A second option is to give all the maps and mountains letter and number codes. Then individuals or small groups can take turns recording matching pairs on a piece of paper.

VIII. Procedure

Day 1: Student groups will:

1. Be given a contour map to glue in the space labeled Map A. They may glue it in either direction.
2. Draw the grid lines marked on Maps A (1 cm apart) and B (2 cm apart). Also draw the grid lines on a second copy of Map B and glue it on the cardboard to be used for making the relief map. Enlarge Map A on Map B by transferring lines, square by square.
3. Figure scale by doubling Map A's scale.
4. Draw the cross sections of both maps on the second worksheet. See Background Information for an explanation of this task.
5. Compare the cross sections of the larger and smaller maps. Why are they different?

Day 2:

6. Mix flour and salt.
7. Use 16 cm square of cardboard and flour/salt mixture to build a scale model of the mountain (Map B). Let map dry.

Day 3:

8. Study elevation maps and devise a color key for the elevations. Paint the map accordingly.
9. Assemble all the relief maps in one place and, given a contour map, find the mountain(s) that matches.

IX. Discussion

1. Why are the cross sections of Map A and Map B different? (When a map is enlarged, everything appears more spread out or flatter.)
2. What mountain matches this map? (Hold up one of the six maps.)
3. Find pairs of mountains that match.
4. Which mountain is a mesa? (has a flat top and steep sides)
5. If your mountain has a lake, what would be the most likely path of a river flowing from it?
6. When might you want to consult a contour or topographical map? (If you were building the trancontinental railroad or going on an expedition, going on a backpacking trip, finding a lost person, planning a city, etc.)

X. Extensions

1. Double Map B and draw a cross section. Compare to the cross sections of Maps A and B.
2. Bring USGS topographical maps and/or hiking books which show cross sections of trails. One such book is "Sierra South" by Thomas Winnett, published by Wilderness Press (Berkeley, CA).
3. Make up your own map and follow the same procedure.

XI. Curriculum Coordinates

Art/Math/Writing: Design and mark a hiking trail to the top of your mountain. Determine the approximate length of the trail. Write about your hike. Would it be easy, moderate, or strenuous? What kind of vegetation and animal life would you see? Would you camp overnight? What would the weather be like? During what month would you go?

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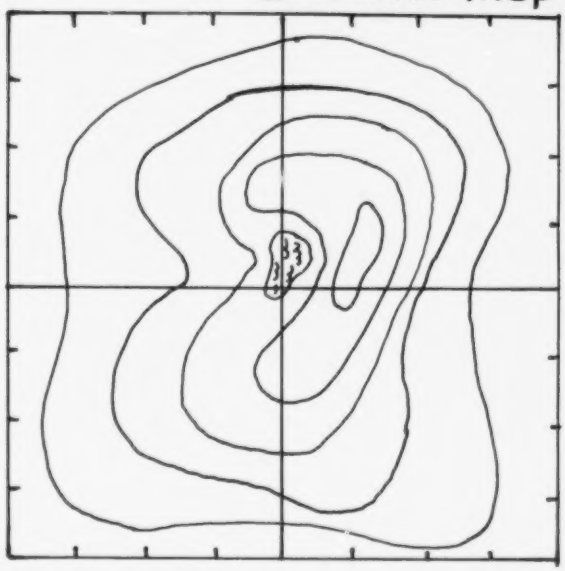
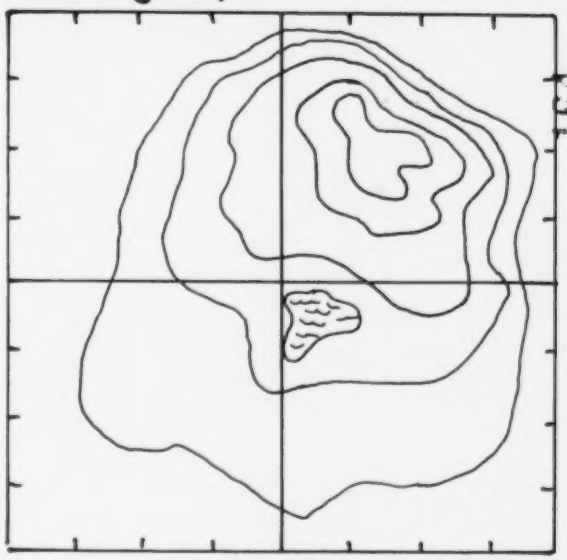
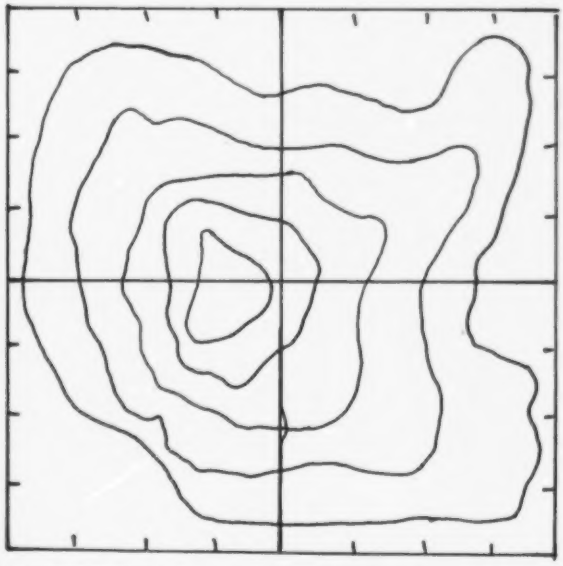
Give one map to each group.

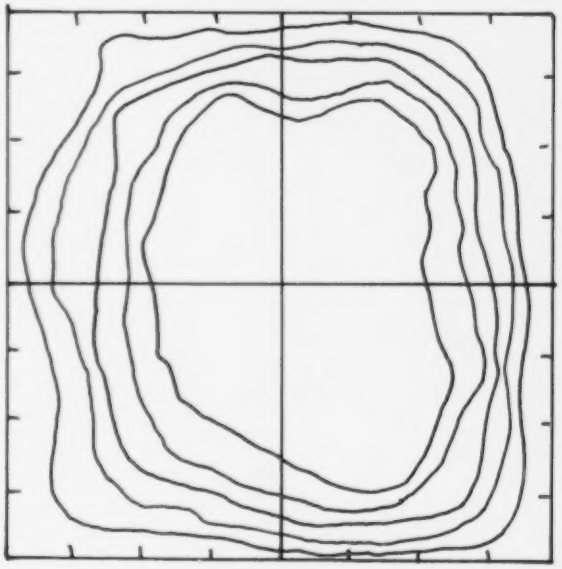
Name _____

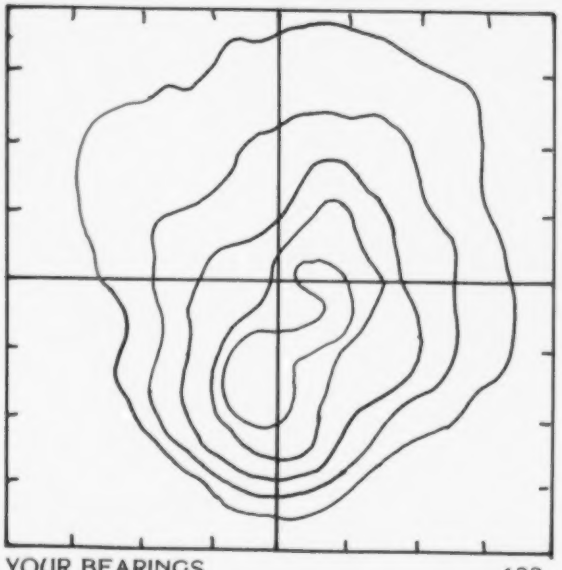
Mystery Mountain

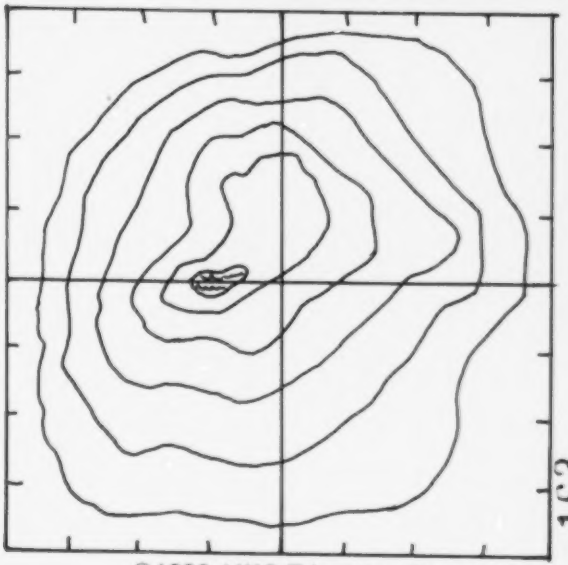












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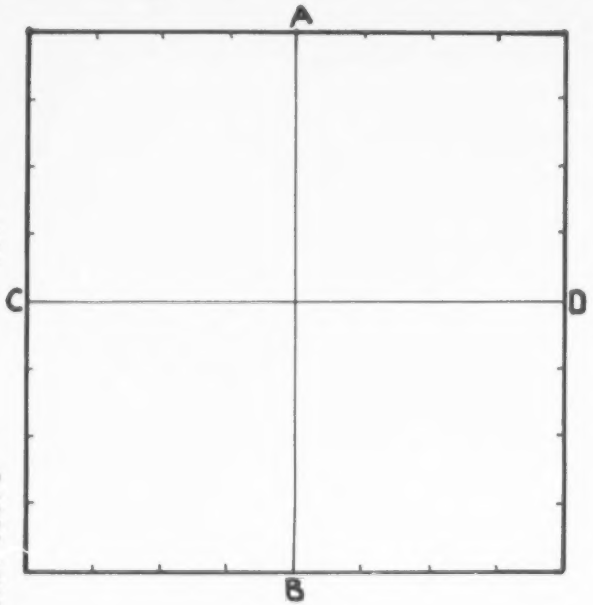
Mystery Mountain

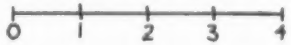
Name _____

1. Glue your map in the space labeled MAP A
2. Use the marks to draw grid lines on both maps
3. Enlarge MAP A on MAP B



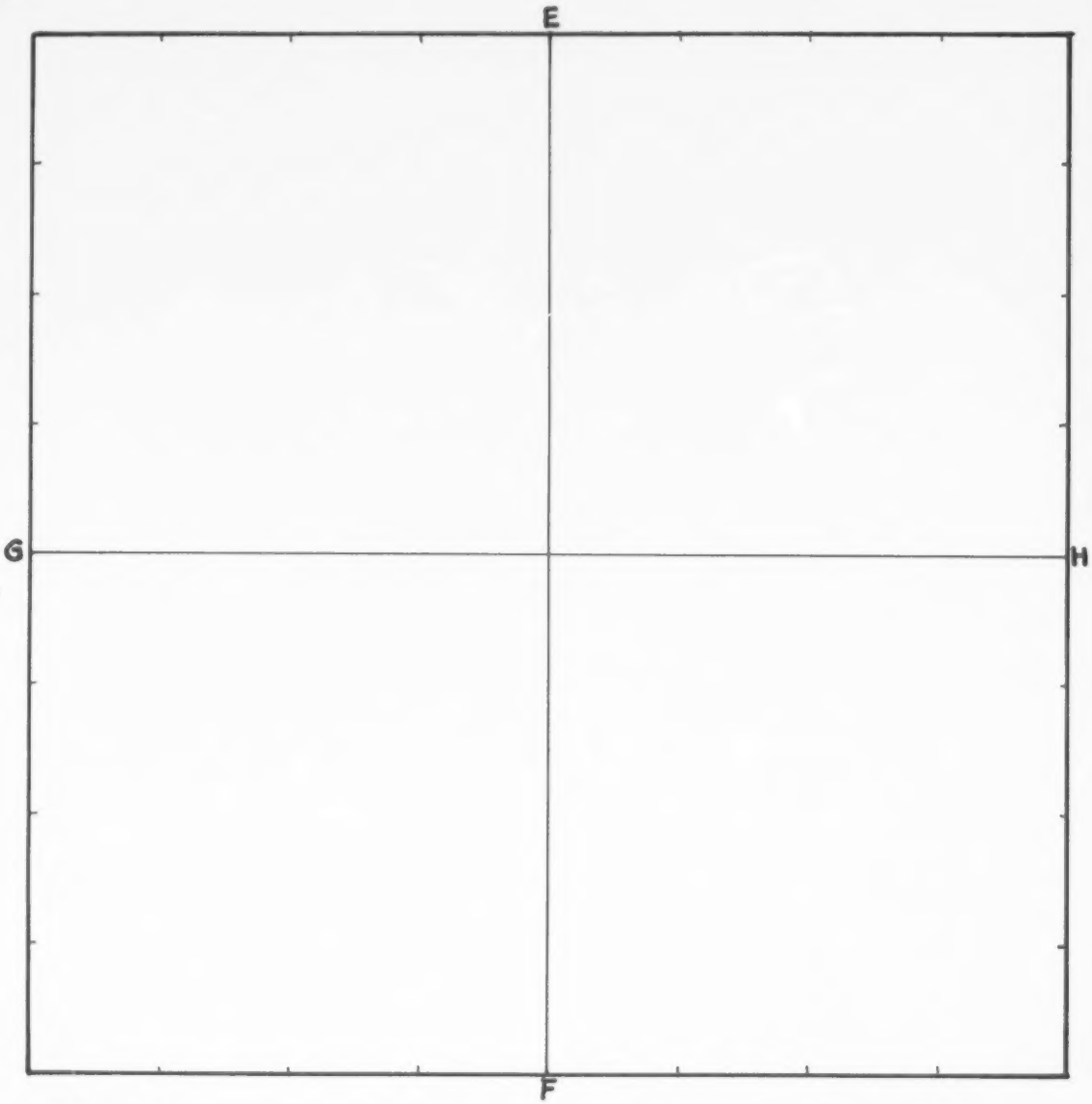
MAP A

Scale: 1 mile to the centimeter



CONTOURS : 500 feet

Lake



MAP B

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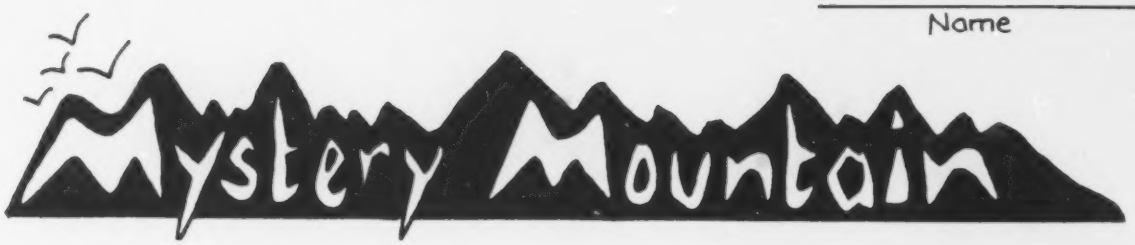
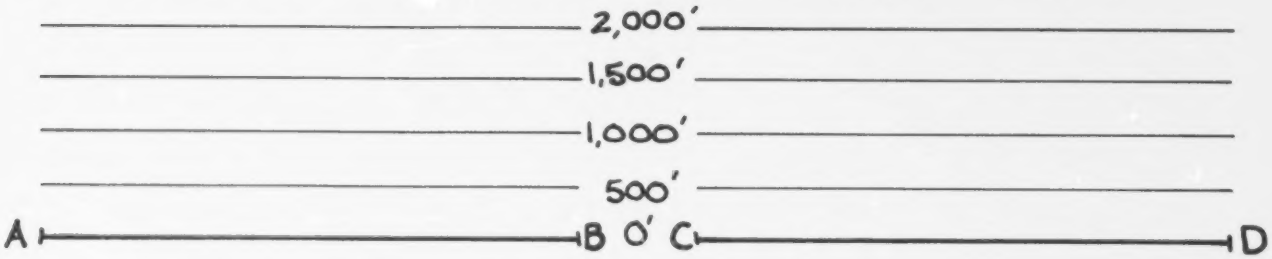
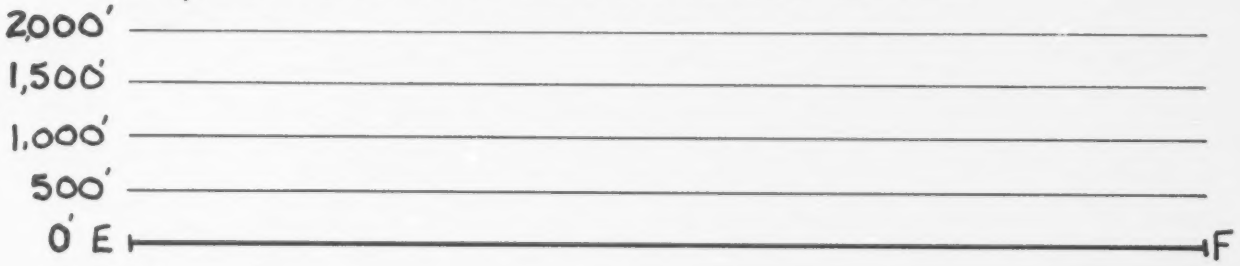
Name _____

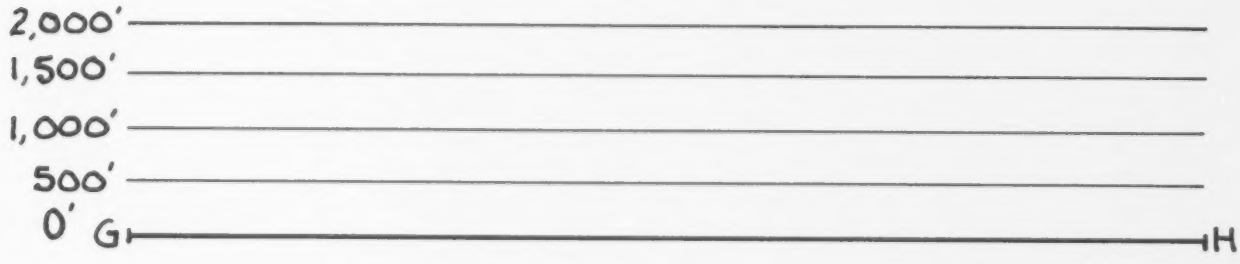


4. Construct cross sections AB and CD from Map A.



5. Construct cross sections EF and GH from Map B and compare with cross sections AB and CD.





6. Build Map B with salt and flour on a 16cm x 16cm piece of cardboard.

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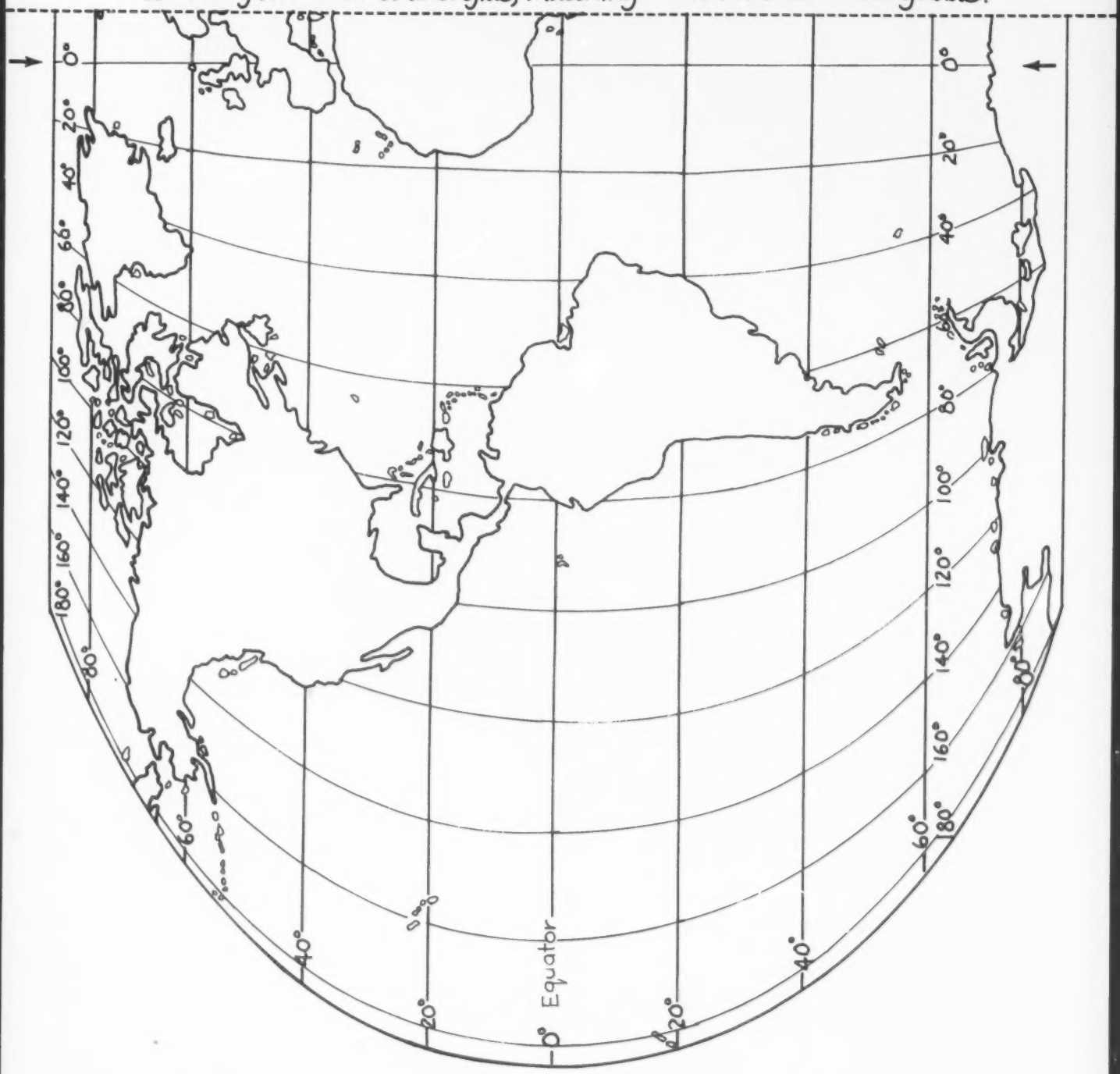
Cut along dotted lines and glue, matching the arrows at 0° Longitude.



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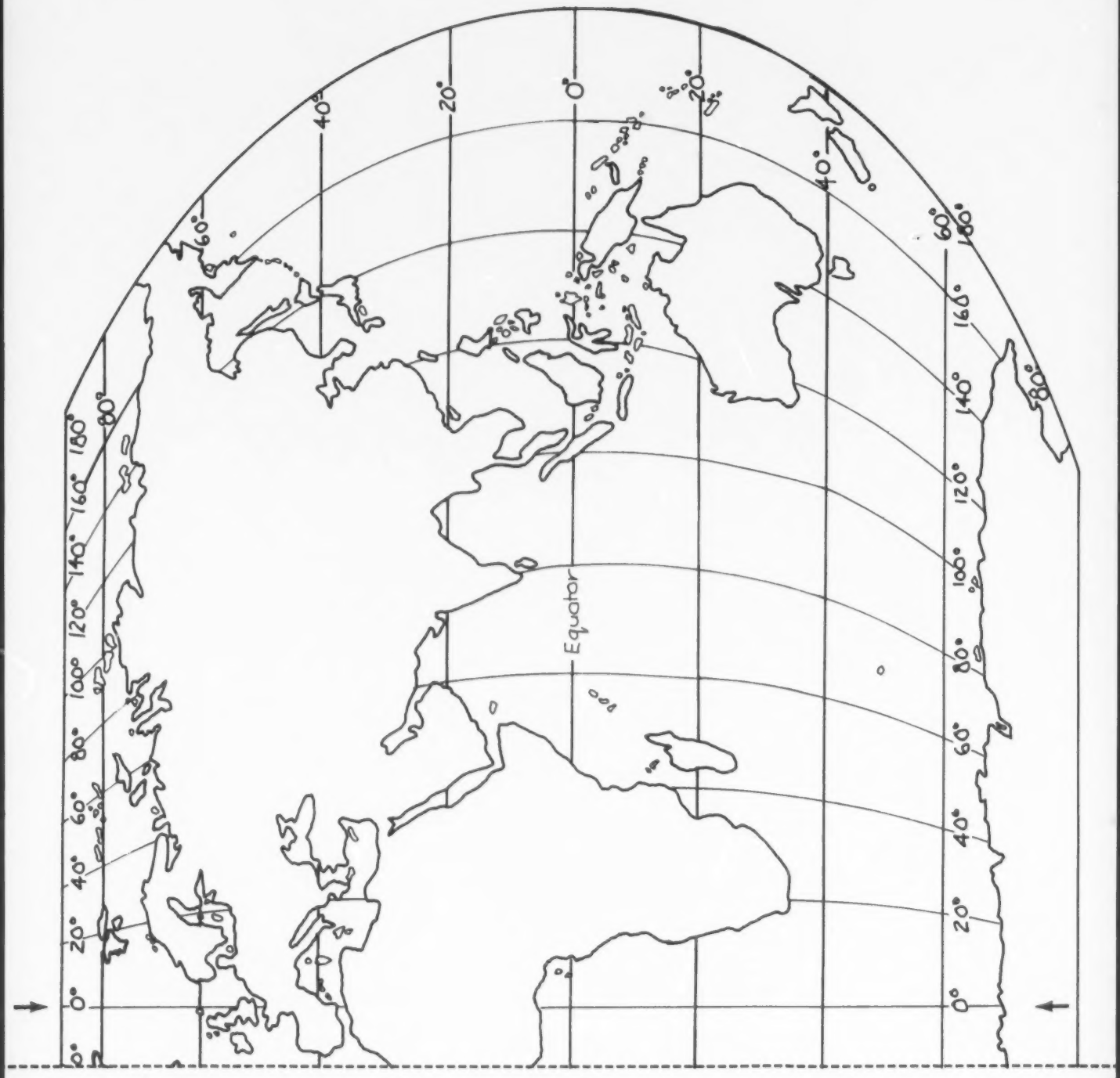

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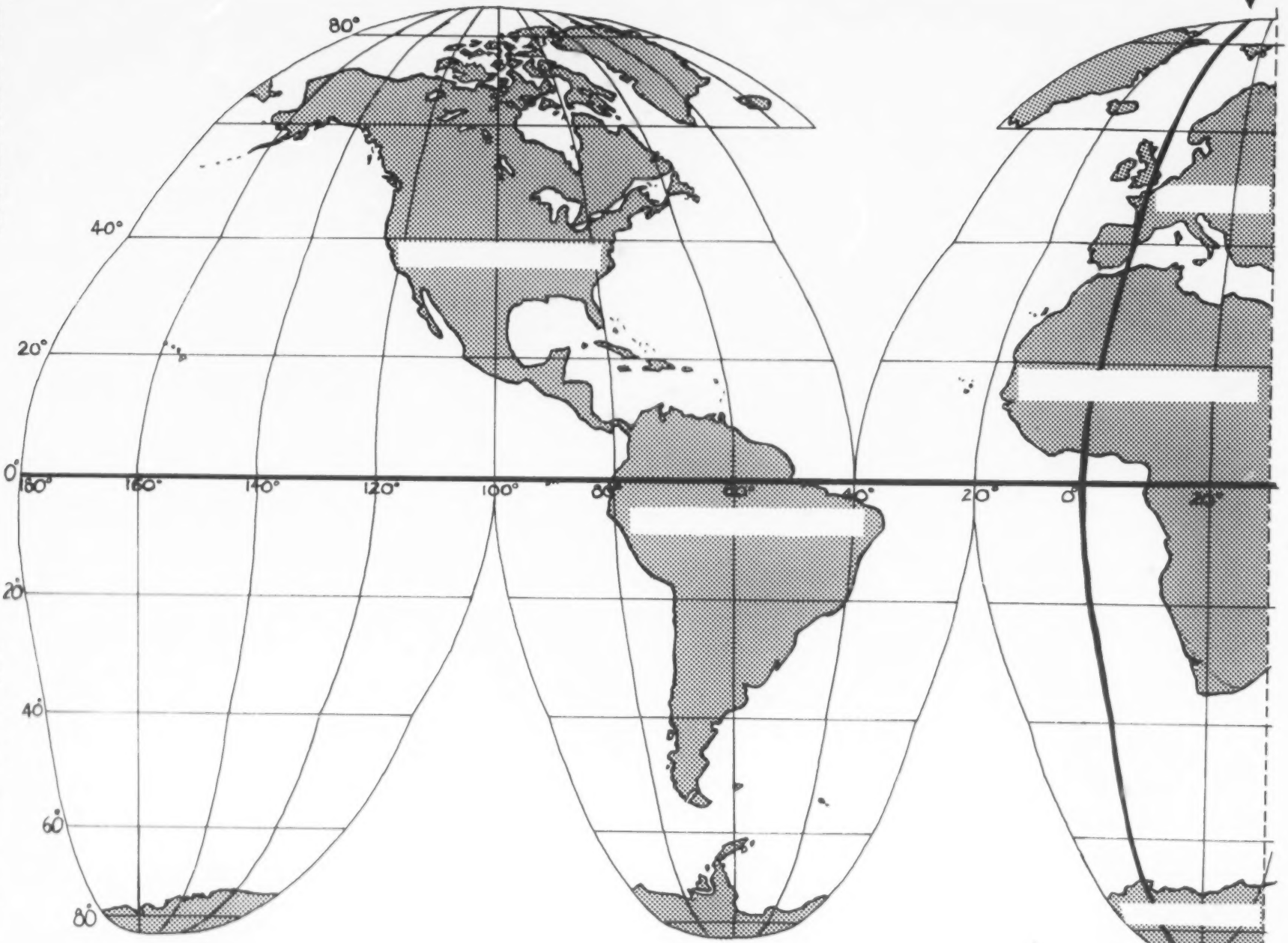

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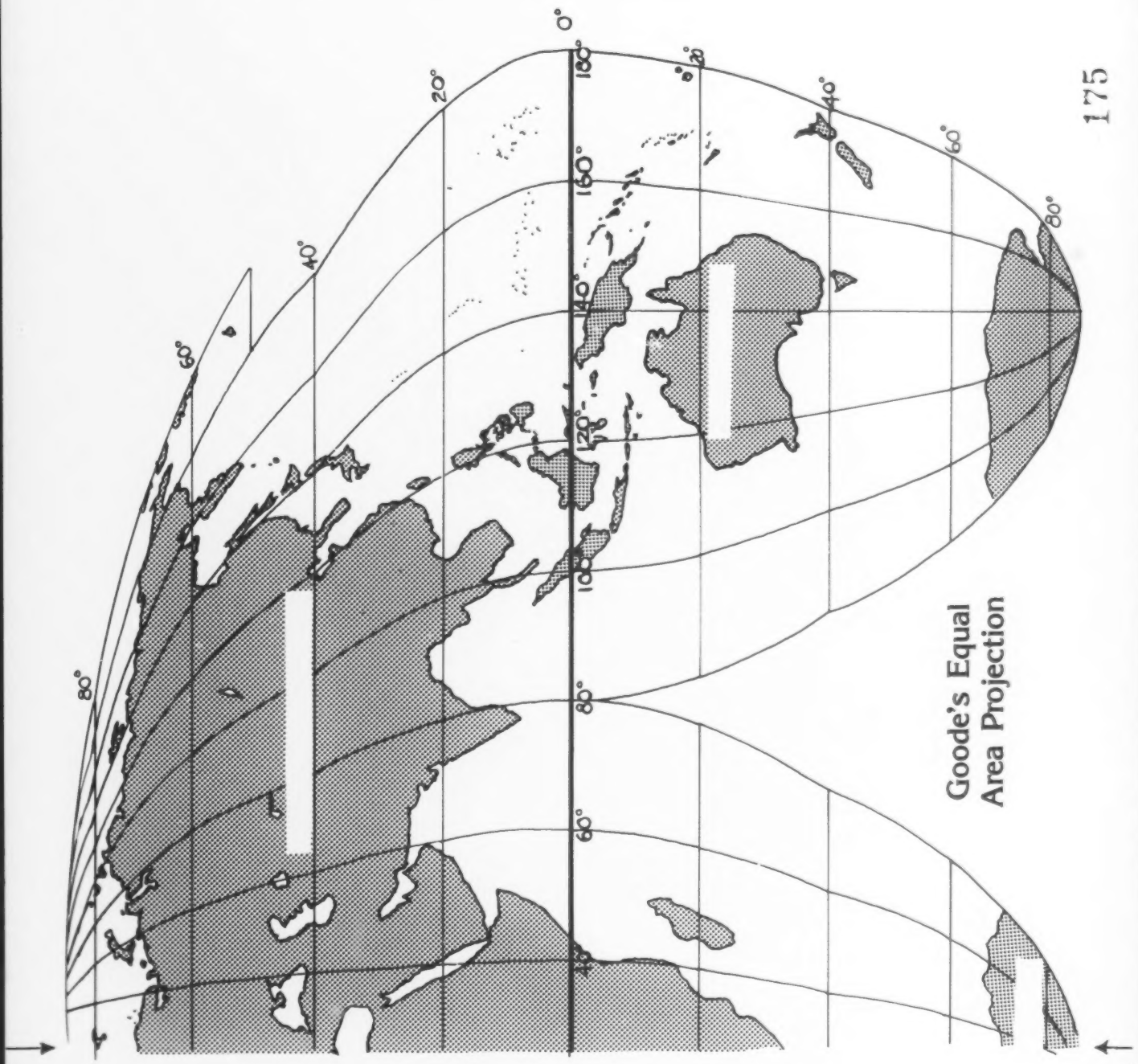

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Cut along dotted line and glue flap.
Be sure that the arrows meet.

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AIMS Education Foundation Programs

The AIMS Education Foundation sponsors a variety of programs and services.
Write for additional current information about any of these:

AIMS National Leadership Program in Math/Science

The Leadership program provides training in science and mathematics for teachers in grades K-9 using the AIMS integrated mathematics/science approach. Intensive training is provided in the physical, biological, earth science, and mathematics topics and the science process skills.

Participants receive 300 hours of instruction in a two-summer sequence. During each academic year following, the participant provides a minimum of 40 hours of instruction to teachers in the local district or region.

Upon successful completion of these requirements, trainers qualify to become members of the AIMS National Leadership Network, conduct AIMS workshops, teach AIMS in-service courses for college credit, and serve as AIMS consultants to help meet the widespread demand for such services.

The program the first summer consists of the AIMS National Leadership Institute (three weeks in July). The second summer schedule consists of the Festival of Mathematics (two weeks in late June). Write for current information.

AIMS One-Week Summer Workshops

The AIMS Education Foundation will offer 50 or more one-week AIMS Workshops nationally each year. The sites are selected from applicant educational organizations who wish to serve as the hosts. Each workshop is of five days duration and includes 30 hours of instruction, primarily hands-on, in AIMS. Most are offered in three grade level sections, generally K–1, 2–4, and 5–9. Participants receive $50+ in materials.

Host agencies agree to provide appropriate classroom space and related services at no cost to the Foundation and to cooperate in the promotion of the workshop. This is the only cost to the host agency. The AIMS Education Foundation pays all instructional costs; the housing, meals, and travel of instructors; and workshop materials and supplies. During 1990 the cost per participant is $195. Instructors are members of AIMS National Leadership Network.

Educational agencies interested in making application to host a workshop should request current information and application forms.

AIMS On-Campus Workshops

Each summer AIMS offers one-week AIMS Workshops at Fresno Pacific College in Fresno, California. The program directors of the AIMS Education Foundation and key members of the AIMS National Leadership Network serve as instructors. Two semester units of graduate credit are available.

Science Festival and Festival of Mathematics

Fresno Pacific College offers outstanding programs each summer: the Science Festival and the Festival of Mathematics. Guest faculty include some of the nation's most highly regarded mathematics and science educators. Provision is made for all grade levels from kindergarten through high school.

These two Festivals offer a unique educational experience and annually draw a total enrollment of more than 600 teachers from across the nation.

"A Day with AIMS"

"A Day with AIMS" offers an intensive one- and two-day AIMS workshops to introduce teachers to AIMS and its philosophy. Participants become familiar with the basic principles incorporated into AIMS; engage in an extensive series of hands-on AIMS investigations; and discuss classroom management and methods for integrating AIMS into the curriculum. Participants receive more than $30 worth of materials, including their choice of two AIMS publications. These workshops can be offered ***in any part of the nation*** based on a minimum enrollment of 30 participants. The cost is $70 per person.

Information Request

Please send current information on:

_____ AIMS National Leadership Program
_____ AIMS On-Campus Workshops
_____ AIMS Off-Campus Workshop Schedule
_____ Science Festival
_____ Festival of Mathematics
_____ "A Day with AIMS" Schedule
_____ "A Day with AIMS" hosting information

Name: _____

Address: _____
Street City State Zip Code

Mail to: **AIMS Education Foundation, P.O. Box 8120, Fresno, CA 93747**

Standard and Expanded AIMS Duplication Programs

It is the goal of the AIMS Education Foundation to make its materials and programs available to schools and educators at reasonable cost consistent with the maintenance of high standards of quality.

The support for continued research, development, field-testing, and publication of AIMS materials is dependent entirely on the revenue produced from the sales of books, posters, the AIMS Newsletter, and other publications of the Foundation.

It is, therefore, of utmost importance that all educators and educational agencies carefully observe the generous privileges and applicable restrictions for duplication.

Two broad types of duplication privileges are offered: standard and expanded. Within the expanded duplication program Class I and Class II contracts are available. Each of these is defined in detail below.

Standard Duplication Privileges

A school or individual purchasing any AIMS publication is granted the right to make up to 200 copies of any of the materials therein for use by teachers at that school site.

Workshop leaders may make up to 200 copies in the same manner as schools. Teachers receiving copies from workshop leaders may duplicate no more than 35 copies of student pages received in a workshop or enough to use the lessons one time with one class. Any further duplication without the purchase of the materials is strictly forbidden.

All educators conducting AIMS workshops are expected to explain the Model of Mathematics and Model of Learning and consistently refer to it as activities are presented since these Models are the basis on which the AIMS program rests. Such understanding is essential to achieve the highest possible benefit from AIMS.

If an educational agency publishes a newsletter or similar publications for distribution to multiple sites, no more than 200 copies of any AIMS materials included therein may be made without written permission from the AIMS Education Foundation. Further, such multiple-site newsletters may duplicate no more than one science activity and one mathematics activity from any one issue of the AIMS Newsletter or book.

Whenever AIMS materials are duplicated in any form the AIMS Education Foundation copyright must appear. In the case of newsletters or similar publications information regarding the availability of AIMS publications and the fact that they may be ordered from the Foundation must be noted.

Extended Duplication Contracts

The AIMS Education Foundation has approved programs whereby schools, school districts, and other non-profit educational agencies may purchase additional duplication rights. These programs are particularly appropriate for districts who wish to publish AIMS materials in a central office for district-wide use or to publish more than the 200-copy limit which comes with the purchase of a book.

Two classes of rights are available:

A Class I contract provides for the purchase of the right to duplicate an additional 250 copies beyond the 200-copy limit that accompanies the purchase of a book; and,

A Class II contract permits the duplication of an unlimited number of copies for use at given school sites. **A special provision of this contract extends this duplication right to revised editions of any of the books covered.**

Both Class I and Class II contracts are based on the **book/site unit.**

A book/site unit consists of duplication rights for one book for use at one school site.

The Class I contract price is $10.00 per book/site unit.

The Class II contract price is $20.00 per book/site unit.

Examples of Contract Elements and Costs

District A wishes to purchase Class I duplication rights for 8 books to be used in 6 of its schools. The cost is computed as followed:

8 books x 6 sites x $10.00 = $480.00

District B wishes to purchase Class II duplication rights for 16 books at 10 sites. The cost is computed as follows:

16 books x 10 sites x $20.00 = $3200.00

A purchase order submitted to the AIMS Education Foundation needs to clearly specify each of the following:

1. The titles of all of the books involved.
2. The number of sites for which duplication rights are being purchased.
3. The class of contract that is requested.

The AIMS Education Foundation will complete the contract authorizing the requested duplication rights and remit it to the contracting educational agency.

Address all correspondence and purchase order to:

AIMS Education Foundation
P.O. Box 8120
Fresno, California 93747

AIMS Newsletter Subscription Information

Each issue of the AIMS Newsletter contains a wealth of resources consisting of new AIMS integrated mathematics/ science investigations, simple science experiments, and problem solving mathematics activities.

The AIMS Newsletter is published monthly, August through May. Subscriptions are on an annual basis only. A subscription entered at any time will receive the 10 issues for that year beginning with the previous August issue. This format is used since many of the articles in an annual volume are interrelated and all need to be available for maximum benefit.

The average issue of an AIMS Newsletter contains four or more new AIMS investigations, at least one each at the K–1, 2–4, and 5–9 grade levels; one 8.5 x 11 inch blackline master poster describing a simple science experiment; two 8.5 x 11 inch blackline master posters displaying problem solving situations; information about developments in the AIMS program, workshops, courses, and other activities; feature articles of lasting value dealing with science instruction, problem solving in mathematics, etc.; a description of how a school, district, or state is implementing AIMS in a systemmatic manner; activities by members of the AIMS National Leadership Network and the writing teams; a thorough preview of all new AIMS and SETUP publications; information about conference presentations by the program directors of AIMS where participants can meet with them personally; and a periodic listing of all AIMS publications.

The problem solving poster series in the Newsletter is accompanied by a thorough analysis of problem solving approaches appropriate to each situation. This analysis serves as an aid to classroom teachers who wish to enhance their own knowledge of problem solving and help students acquire an inventory of problem solving skills. Authored by Wilbert Reimer and Arthur Wiebe, both of whom studied extensively under Dr. George Polya at Stanford University, both series reflect his influence.

The ten issues in the annual volume contain forty or more new AIMS investigations, ten science posters, and twenty problem solving challenges, plus numerous articles dealing with the teaching of "hands-on" science, evaluating higher order thinking skills and student progress in mastering process skills, and other enriching resources.

Since duplication rights for one school site are granted for all materials published in the Newsletter, it is highly cost effective for a school to enter a subscription and build a library for the use of all of its teachers.

The annual subscription price is $22.50. Volumes I and II are still available.

AIMS Newsletter Subscription

Subscriptions are accepted on an annual basis only. Subscriptions entered at any time during the year receive all issues of that year, August – May.

Please indicate quantity:

____ Volume I issues 1986–87
____ Volume II issues 1987–88
____ Volume III issues 1988–89
____ Volume IV subscription 1989–90
____ Volume V subscription 1990–91

Order any one volume for $22.50, each additional volume on this order is $20.00.

Subscription Information:

Name: _____

Address: _____
Street

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City State Zip Code

Make payment to:

AIMS Education Foundation
P.O. Box 8120
Fresno, CA 93747

Extend AIMS Lessons with Children's Literature

During summer AIMS workshops Debby Deal and Gale Kahn encouraged teachers to submit the names of favorite books that related to various AIMS activities. Below are two such lists, one for primary grades and the other for middle grades. We encourage our readers to help us expand these lists. AIMS places heavy emphasis on the integration of learning and is pleased to print the following information.

PRIMARY

Lesson Topic	Book Title	Author
Feet/Shoes	Foot Book	Dr. Seuss
	The Aminal	Bulian
	The Very Worst Monster	Hutchins
	Shoes	Winthrop
	Funny Feet	Weiss
Fruits/Vegetables/Health	The Very Hungry Caterpillar	Carle
	Gregory, The Terrible Eater	Sharmat
Seeds/Leaves	Reason for a Flower	Heller
	Fall of Freddie Leaf	Buscaglia
	Pumpkin, Pumpkin	Titherington
Detective	Detective Whooo	Panek
Ghosts	Georgie The Ghost Book	Bright
	The Haunting of Grade 3	???
	Cranberry Halloween	Devlin
	Great Halloween Scare	???
	The Ghost Eye Tree	Martin
	Little Old Lady Who Wasn't Afraid of Anything	Williams
Rainbow	Plant a Rainbow	Ehlert
	Little Blue and Little Yellow	Lionni
Flower	Plant a Rainbow	Ehlert
	The Reason for a Flower	Heller
Start of School	The Blanket Had To Go	Evans
Fish	Fish Out of Water	???
	Yeh-Shen	Louie
Bears	Teddy Bear Picnic	Kennedy
	Corduroy	Freeman
	When a Bear Bakes a Cake	Tomkins
	Ten Bears in My Bed	Mack
	Big Bad Bruce	Peet
	Teddy on Time	Pellowski
Eggs	Are You My Mother?	Eastman
	Chickens Aren't the Only Ones	Heller
	Seven Eggs	McKenna
	What's Hatching Out of That Egg	Lauber
Snails	The Biggest House in the World	Lionni
	Snails Spell	Ryder
Dinosaurs	Weekly Reader — Dinosaur Kit 4343 Equity Dr., Columbus, OH 43228 Pat Perea Materials, S/S Pub. Co. 3550 Durock Rd. Shingle Springs, CA 95682 (916) 677-1545	
	Dinosaur Pop-up Book	Barlowe
	Patrick's Dinosaur	Carrick
Popcorn	The Popcorn Book	de Paola
	Popcorn	Asch
Measurement	Inch By Inch	Lionni
	How Much Is A Million?	Schwartz
Animals	Annie and Wild Animals	Brett
	The Big Snow	Hader
	Dear Zoo	Campbell
	Animal Fact/Animal Fable	Simon
	Animals Born Live and Well	Heller
Camouflage	How to Hide a Butterfly	Heller
	Where's Waldo	Handford
	The Trek	Jonas
	Animals Who Change Their Color	Almand
Pet Rock	Everybody Needs a Rock	Baylor
Jelly Beans	The Jelly Bean Contest	???
Eyes	People	Spier
	Illusions	Troll Assoc.
Art	Make a World	Emberley
Hermit Crabs	Does Anyone Know Where a Hermit Crab Goes?	???
Space/Sun	The Sun Our Nearest Star	Branley
	What Makes Day and Night	Branley
	Done in the Sun	Hillerman
Weather	Snow is Falling	Branley
	Sunshine Makes the Seasons	Branley
	Flash, Crash, Rumble and Roll	Branley
	Cloudy with a Chance of Meatballs	Barrett
Shadows	Shadow Chaser	Cosgrove
Miscellaneous	Do You Know?	Ford
	The King Who Rained	Gwynne
	The Jolly Postman	Ahlberg
Creature Features	Where the Wild Things Are	Sendak
Fun Fruits	Huge Harold	Peet
	Hubert's Hair Raising Adventure	Peet
Bubbles	Unbelievable Bubble Book	Cassidy
Apples	Ten Apples up on Top	Dr. Seuss
Observation	Anamalia	Base
	Wilfred Gordon McDonald Partridge	Fox
	Do Not Open	Turkle
Corn	Corn is Maize	Aliki
Moon	Moonbeam on a Cat's Ear	Gay
Questions	How Come?	Richards
Nature	King's Flower	Anno
Body Parts	Here Are My Hands	Martin, Jr.
Insects	Squiggly Wiggly's Surprise	Shapiro
	How Many Bugs in a Box	Carter
Senses	Series. . . Sight, Hearing, Touch, Smell, Taste	Ruis
Self Esteem	Quick as a Cricket	Wood
Birds	Owl Moon	Yolen
Numbers	Anno's Counting Book	Anno
Water Fun	King Bidgood's in the Bathtub	Wood
Magnets	Mickey's Magnets	Cranley
Serial Ordering	Where in the World is Henry?	Balian
Asking Questions	Owly	Thaler
Heat, Water	Snowy Day	Keats
Earth/Physical Science	Pecos Bill	Kellogg
Songbook	All Year Songbook	Scholastic
Plants	Seedling Child	Bornstein
Critters	Fables	Lobel
	Aster Ardvarks Alphabet Adventures	Kellogg
	Barn Dance	Martin
	Q is for Duck an Alphabet Guessing Game	Elting
	Silkworms	Johnson
	Very Hungry Caterpillar	Carle
	Predator Prey Puppets	Mah
	Beastly Neighbors	Rights
Foods	Alligator Arrived with Apples	???
	A Potluck Alphabet Feast	???
	Cresent Dragonwagon	???
Spiders, Lettuce	Lady and the Spider	McNulty

MIDDLE GRADES

Lesson Topic	Book Title	Author
Rocks	Everybody Needs a Rock	Baylor
	Sylvester and the Magic Pebble	Steig
Measurement	How Tall Was Milton	Lowery
Insects	101 Bug Jokes	Eisenberg
General Information	What?	Reece
	Random House Book of Poetry	Prelutsky
Camouflage	How to Hide. . . Series	Heller
Seasons	Frederick	Lionni
Animals	Animals Born Alive and Well	Heller
Ecology	Introducing Ecology: Nature at Work	British Museum
Music	Peter and the Wolf	
Senses	Look Again	Hoban
Fractions	Gator Pie	Mathews
Boats	Paddle to the Sea	???
	Three Days on a River in a Red Canoe	Williams
Geology	Ming Lo Moves the Mountain	Lobel
Classification	Bruno Brontosaurus	Rubel
Weather	Cloud Book	de Paola
Bears	Baby Bears	National Geographic
	Happy Birthday Moon!	Asch
	Corduroy	Freeman
	Who Wants an Old Teddy Bear?	Hofmann
	Teddy Roosevelt and his Teddy	???
Popcorn	The Popcorn Book	de Paola
Numbers	How Much Is a Million?	Schwartz
Multiplication	Bunches & Bunches of Bunnies	Mathews
Language	The Jolly Postman	Ahlberg
Money	Alexander Who Used to be Rich Last Sunday	Viorst
Mirrors	The Mirrorstone	Palin
	If You Give a Mouse a Cookie	Numeroff

Mathematics: A Way of Thinking
Center for Innovation in Education
19225 Vinegar Lane
Saratoga, CA 95070

Family Math
Univ. of California, Berkeley
Lawrence Hall of Science
Berkeley, CA 94720

Materials: wooden spool (thread) 2"x2" Piece of tagboard Straight pin
Procedure:
1. Make sure to remove the paper labels from each end of the spool
Stick the pin through the center of the
Place the pin and paper on top of the
Tilt your head back and
Make sure
Clown
Materials: Clown
Pencil
2 Coins
Masking tape
Procedure:
TRIANGULAR NUMBERS
Triangular numbers are numbers which can be represented by dots in an equilateral triangular array. The first four triangular numbers are pictured below
COMMON CENTS
Do all pennies have approximately the same mass?
For this investigation, select one set of pennies minted before 1982 and another set of pennies minted after 1982. Find the average mass of each type
Average Mass
Penny
Rubber Eggs
1. First, soak raw eggs in vinegar for abo
will take the calcium out of the shell.
To "see through" the egg's membrane
notice about the eggs in vinegar?
e out 1 decalcified egg. Let it dry. Roll
paper towel, and your arm. What do yo
nd 2 decalcified eggs of about the same si
paper towel. Estimate, then weigh and m
for each
Egg # 1
Egg # 2
Mass
Circumference
4. Place egg # 1 into a jar of water and e
corn syrup. Describe your observations
think will happen:
Take
TEDDY BEARS
Playing in the Den
eddy Bears are playing a game in their den. They are hidden from
the while, 6 are sent out while the rest lay their plans. In
the 6 who come out are selected at random. Some have been
ut before. Some are sent out for the first time.
Your task is to make the best guess as to how many
Teddy Bears there are of each color.
ess
think there will be more _____ Teddy Bears than any other
think there will be fewer _____ Teddy Bears than any oth
ick out 6 Teddy Bears for each sample without looking in the de
the number of Teddy Bears of each color in the sample has been
hem back into the den, mix them up thoroughly, and pick 6 n
mples have been checked.
Blue
Red
Green
First Sample
Second Sample
Third Sample
Fourth Sample
AIMS NEWSLETTER
A Publication of the AIMS Education Foundation
Volume 1, Number 6
January, 1987
AIMS On Target In China
Chinese Students Measure Up
Rose Lee Patron
AIMS NEWSLETTER
A Publication of the AIMS Education Foundation
A Non-Profit Tax Exempt Foundation
Volume 1, Number 7
February, 1987
AIMS Education Foundation Outlines Five-Year Plan
Auburn, AIMS, Action!
Activity-Centered Science Partnership
Dr. Del Alberti, Auburn District Superintendent
DA Pecked Pineapple
Circumference
Estimate
Measure
Find Difference
I think the greatest circumferenc
I measured and the greatest
There was a difference between my estim
Height
the height of the pine
the actual height
The TEDDY BEARS Go Sledding
1.
2. A third
a blue
in the
Basic Operations and the Model of Mathematics
Dr. Arthur Wiebe
AIMS NEWSLETTER
A Publication of the AIMS Education Foundation
December, 1986
AIMS Education Foundation
Hawaii Selects AIMS for Statewide Program
Miles Muroaka
State Educational Specialist in Science
Diagonal Challenge
Find the total number of diagonals in a polygon with 12 sides by first examining a polygon with 5 sides, then a polygon with 4 sides, etc. until you see the pattern that emerges. Use the chart to record your results.
Number of Sides
Number of Diagonals
0
The Fascinating Triangle
EGG FACTS
Minerals: iron, phosphorus, vitamins A+D
A relatively small amount of

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